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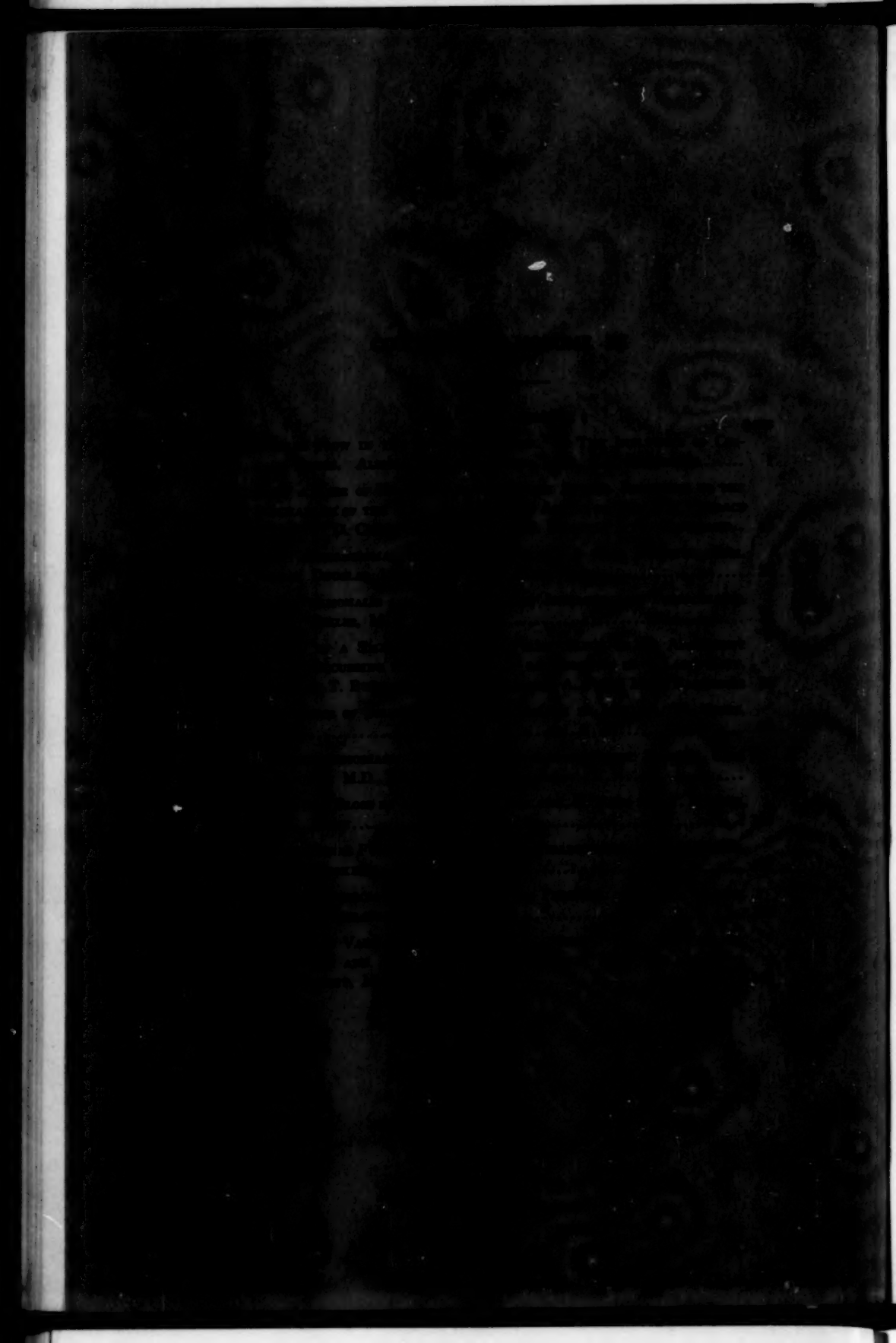

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AN ERROR IN THE ELECTROCARDIOGRAM ARISING IN THE APPLICATION OF THE ELECTRODES *

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In the course of work with the electrocardiograph, there has come to my attention a phenomenon which introduces an error so large as to be of considerable importance. It is evident in Figure 1, and consists in the fact that when a constant difference of potential is applied at two points of the circuit containing the galvanometer and the patient, the resulting deflection of the string takes the form of a quick jump, as quick as the instrument can make, followed by a slow partial return toward the base line. The return takes the form of a curve such as can be seen in the figure (Fig. 1), and has a duration of from 0.1 to 0.4 second in different instances, being short when the overshoot is small, longer when it is large. When the string reaches this new level the deflection remains constant, the movements due to the heart's currents being superposed on this new base line as they were on the former one. The overshooting and slow return are usually evident to the eye of the observer in the process of standardization which is carried out before taking each lead of the electrocardiogram.

That others encounter this phenomenon is certain, for I have seen it in the records of two operators, and just recently Robinson[1] has described what must be this overshooting when he says, "Only those records have been used in which this adjustment (standardization) did not render the string sufficiently slack to cause any marked fling, which results in a definite deformity of the curves." Slacking the string is necessary when standardizing for a high resistance, but slacking the string does not lead to the appearance of "fling"; on the contrary, it causes the deflection to become slower, and to reach its maximum more gradually. A *tight* string may become periodic and go too far at first, but never when working at the sensitiveness used for electrocardiograms, unless the field strength of the magnet is very weak.

* Submitted for publication Feb. 5, 1917.

* From the Department of Physiology, College of Physicians and Surgeons, Columbia University, and from the medical services of the New York Hospital.

1. Robinson, G. C.: The Relation of Changes in the Form of the Ventricular Complex of the Electrocardiogram to Functional Changes in the Heart, THE ARCHIVES INT. MED., 1916, **18**, 830.

As it is customary to standardize so that a difference of potential of 1 millivolt placed in series with the galvanometer and the patient will produce a constant deflection of 1 cm. in the base line of the record, it is readily seen that the above condition produces an error in the height of the waves of the electrocardiogram. The differences of potential producing the Q, R and S waves being of practically instantaneous production, will cause the instrument to overshoot, as it does when we apply the standard current to a degree proportional to the magnitude of the currents of the Q, R and S waves. The P and T waves, being of more gradual onset, will allow, during their development, a varying degree of the gradual return toward the base line so evident in the figure, and will accordingly not be increased proportionally to their height — will not be so high as the quicker waves — for the same strength of current within the heart. The net result then

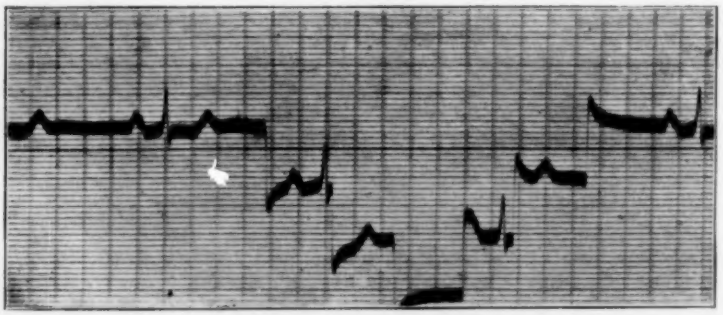

Fig. 1.—Application of successive millivolts in series with galvanometer and patient. German silver electrodes, Lead II; resistance measured as described, 5,000 ohms.

In this and all succeeding records the time interval between the corresponding line of successive pairs of ordinates is equal to 0.20 second. The distance between abscissae, 1 mm. in the originals, represents 0.1 millivolt.

All records should be read from left to right.

is a deformation of the electrocardiogram, and as this condition may be operative to a different extent in each lead, varying, as we shall see, with the apparent resistance, it will make impossible the comparison of records from the same person taken at different times, and will preclude the possibility of working out the direction of the potential within the heart which gives rise to a given wave or peak in the three leads.[2]

It was found that this effect was obtained only in cases in which

2. Einthoven, Fahr and de Waart: Ueber die Richtung u. die manifeste Grösse, etc., Arch. f. d. ges. Physiol., 1913, **150**, 275. Also Pardee, H. E. B.: Form of Electrocardiogram, Jour. Am. Med. Assn., 1914, **62**, 1311.

the resistance through the patient was relatively high, over 2,000 or 2,500 ohms. It appeared best when the resistance reached 4,000 ohms or more, being increasingly evident with higher resistance. Resistance through the patient was measured by substituting in the galvanometer circuit a resistance box instead of the patient, and determining the number of ohms which must be used in this box in order to make the deflection of the string equal to the deflection caused by the same potential

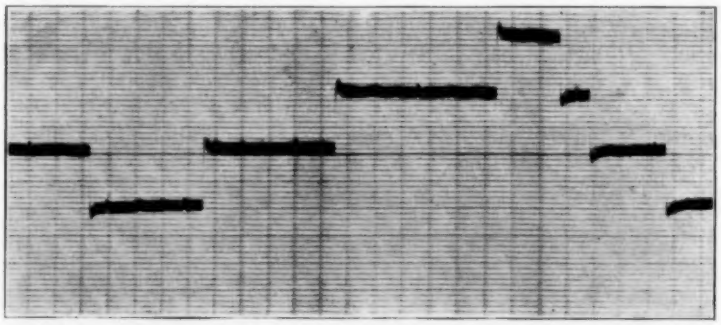

Fig. 2.—Application of successive millivolts as before, except that the lead is from the two legs, in order to minimize the electrocardiogram and make the overshooting more plainly visible; resistance 3,500 ohms.

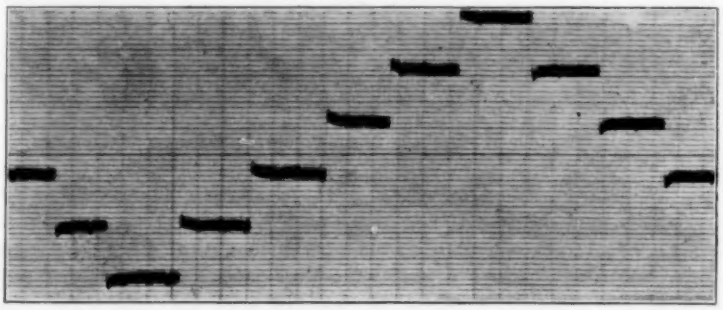

Fig. 3.—Conditions the same as in Figure 2, except that nonpolarizable electrodes were used as described in the text; resistance 3,600 ohms.

when introduced in the circuit of the patient and galvanometer; that is, 1 cm. deflection for 1 millivolt in each case. As a rule, the resistances measured by this method vary from about 500 to 1,500 ohms, usually about 1,000 ohms.

It was thought at first that this overshooting effect might be due to polarization of the electrodes, since these were not of the conventional nonpolarizable type. They consisted of a plate of German silver

about 12 by 25 cm. This was placed on the forearm or leg after the skin had been covered by a bandage soaked with strong salt solution, and the bandage was then continued over the outer surface of the metal plate. The plate was connected to the wires going to the galvanometer.[3] Polarization of the electrodes as a cause of the phenomenon was disproved by two observations: (1) The outer layer of bandages was removed from the outer surface of the metal plate and the plate was removed. The bandage being left about the extremity, its free end was immersed in a porous cup of salt solution, and this was set in a solution of zinc sulphate. The wires were attached to an amalgamated zinc plate immersed in this solution. This is a true nonpolarizable cell, and a record of the patient under these conditions showed the same resistance and the same overshooting on the application of a millivolt

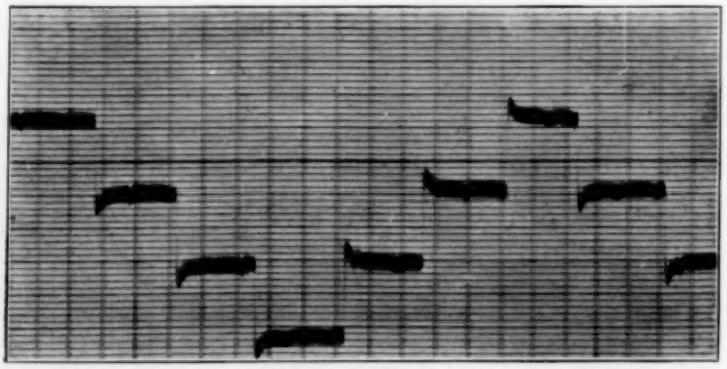

Fig. 4.—Application of millivolts as in Figure 2; resistance 4,000 ohms.

as was obtained with the German silver electrode. This is shown in Figures 2 and 3. (2) If the two metal plates were wrapped in a bandage soaked in salt solution, and were connected together by a sufficient length of bandage to make the resistance equal to that of the patient, for example, 4,000 ohms, then the application of a millivolt caused a prompt, maintained deflection with no signs of overshooting. This is identical with the curve obtained when two nonpolarizable cells are connected together by a bandage, and gives no evidence of polarization.[4]

It was further determined that this phenomenon is not due merely to the presence of a high resistance in the circuit, for if 10,000 ohms are introduced in series with the patient and galvanometer, it does

3. A full description of this electrode and of control tests will appear shortly.
4. See electrode article referred to in footnote 3.

not cause the phenomenon to appear in patients who do not otherwise show it.

What then is its explanation, and how can it be avoided? It was noticed that the phenomenon appeared chiefly or only in patients with a dry, rather bloodless type of skin, and, as has been said, only when the resistance as measured by the usual technic approached 2,000 ohms or more. It was also noticed that as the wet bandage remained longer about the extremity, the resistance as measured would gradually decrease, and with it the extent of the overshooting. Remembering that it is not the total resistance of the circuit which causes the appearance of this phenomenon, these facts lead to the conclusion that it is due to the local condition of the skin of the patient, either in the horny layer, or in the cutis as a whole.

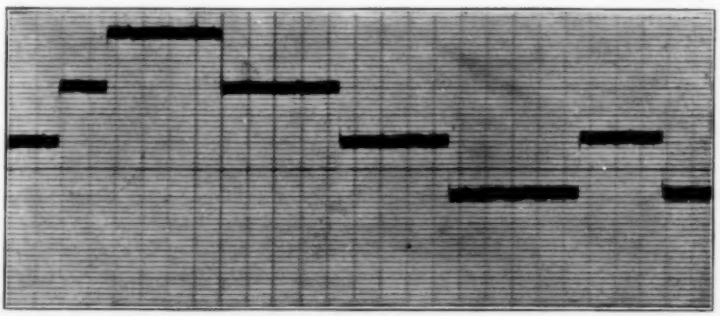

Fig. 5.—Obtained immediately after Figure 4, and with German silver electrodes, but the legs were first scrubbed with a hot salt solution and a hot bandage was applied; resistance 900 ohms.

What this condition is and how it acts to produce the effect noted, are at present undecided, though there seem to be two possibilities in each of these questions. The condition may be a dryness of the horny layer of the epidermis, or a vasoconstriction of the cutaneous vessels. The latter explanation is favored at present, because the phenomenon has been seen in several instances to pass off in such a very brief period of time, the resistance falling from 4,000 to 1,000 ohms, and the overshooting disappearing entirely in less than a minute, while in one instance the resistance rose just as suddenly from 1,200 to 4,500 ohms, and the overshooting, which had not been evident to the naked eye, became plainly so. Either of these conditions might cause the overshooting phenomenon by leading to polarization at the cutaneous surface or within its structure, but it is thought most likely that it is due to the skin functioning as a condenser surface, making the over-

shoot due to the charging of the condenser, and the slow decline due to its partial discharge through the resistance of the circuit.[5]

To avoid this source of error has been found comparatively easy, since its cause was approximated in this way, though before that time it was of common occurrence. The most important measure has been found to be the application of a hot bandage. The salt solution should be hot, preferably about 105 F., so that it stings the hand of the person applying the bandages. Of lesser importance has been found to be a thorough rubbing and wetting of the skin of the exremity before the bandage is applied. This alone will not usually suffice, but is an important accessory measure. In Figures 4 and 5 are records obtained before and after this treatment, showing the complete disappearance of the phenomenon.

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5. This investigation has been discontinued owing to its extreme technicality, and to the fact that the source of error may be avoided with the knowledge now at our disposal.

STUDIES IN PROTEIN INTOXICATION

I. BLOOD COAGULATION *

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Since the first report on the use of human serum in certain diseases of the skin six years ago,[1] varying reports of its value for these conditions have appeared, many of them favorable. The work here reported is a continuation of that started by Swann,[2] and is concerned with further studies on the use of human serum in urticaria, especially regarding the effect of such serum on the coagulation factors of the blood in this condition.

Urticaria is believed by many to be an anaphylactic manifestation. Swann's[2] observation of the delayed coagulation of the blood in the case of urticaria he studied harmonizes with the conception of urticaria as a clinical manifestation of anaphylaxis, as in the latter condition the coagulation time of the whole blood is definitely delayed. Strickler[3] found that eight out of ten cases of urticaria showed positive anaphylactic skin reactions, even though the results of these tests did not, as a rule, lead to therapeutic success. McBride and Schorer[4] have pointed out the definite position of anaphylaxis as a cause of urticaria, assigning most cases to that cause.

Widal[5] and his co-workers observed in their study of chronic urticaria that the ingestion of animal proteins to which the individual was sensitized, induced a series of disturbances definitely anaphylactic in character, namely, a fall in blood pressure, leukopenia, hypercoagulability (?) of the blood, profound lowering of the refractometric index, a rise of temperature and albuminuria. He concluded that these findings are caused by the passage of heterogeneous albumins into the blood.

The beneficial results obtained in some cases of urticaria from protein restriction in accordance with positive anaphylactic skin reactions, also lend weight to this view, as does the urticaria observed in indi-

* Submitted for publication April 12, 1917.

* From the Department of Pathology and the Medical Clinic, Presbyterian Hospital, Columbia University.

1. Mayer and Linser: München. med. Wchnschr., 1910, **56,** 2757. Linser, P.: Med. Klin., 1911, **7,** 1361; Verhandl. d. Cong. f. inn. med., 1911, **28,** 125, and Arch. f. Dermat. u. Syph., 1912, **113,** 701.
2. Swann, Arthur W.: Jour. Am. Med. Assn., 1915, **64,** 737.
3. Strickler, Albert: New York Med. Jour., 1916, **104,** 198.
4. McBride and Schorer: Jour. Cutan. Dis., 1916, **34,** 70.
5. Widal, F.: Bull. et mém. Soc. méd. d. hôp. de Paris, 1914, **37,** 256.

viduals after the ingestion of certain food. The almost constant appearance of general urticaria in such a definite anaphylactic conditions as serum disease is also most suggestive.

These considerations led me to precede my study of the coagulation factors in urticaria and the influence on these factors of human serum therapy, with a study of the blood in experimental anaphylactic guinea-pigs and in cases of serum sickness in man.

Biedl and Kraus[6] first observed the delay or loss of coagulability of the blood of dogs suffering from anaphylactic shock. The delay amounted to hours or days. Friedberger[7] found that the coagulability of the guinea-pig's blood is lessened in anaphylaxis, but the diminution was slight as compared to that described by Biedl and Kraus[6] in the dog, the delay being only a matter of minutes. Since then, other workers have observed the same condition, in this country, Pepper and Krumbhaar,[8] Lee and Vincent,[9] and recently Minot.[10] Many have the impression that the delayed coagulability of the blood in anaphylactic animals is a matter of hours or days and of uniform occurrence in all anaphylactic animals. That this is not the case was shown first by Friedberger.[7] Pepper and Krumbhaar's[8] report of their work with dogs, in which the delay is most marked, shows that in only four out of seven cases reported did the delay amount to hours instead of minutes. Lee and Vincent[9] give no figures. Minot's[10] results were essentially the same. My work was confined to guinea-pigs.

The following was the technic used: Guinea-pigs were given a sensitizing intravenous injection of 0.5 c.c. of horse serum. Twenty-one days later a second 0.5 c.c. of horse serum was given and if anaphylactic shock developed, as shown by convulsions, dyspnea, weakness, involuntary defecation and urination, etc., blood was drawn from the heart and one portion put at once into sodium oxylate solution and later tested for the amount or efficiency of prothrombin, Howell's[11] method as described by Minot[12] being employed. Antithrombin was tested by the method described by Hess.[13] A second portion was used to test the coagulation of the whole blood by the method described by Lee and White.[14] Every effort was made to carry out the methods just mentioned, as exactly described by the various authors, with the utmost care as to the details of the technic.

As the blood of only one anaphylactic guinea-pig was tested on any one day, a normal nonanaphylactic guinea-pig's blood was used as a control in each case. The results of these studies appear in Table 1.

6. Biedl and Kraus: Wien. klin. Wchnschr., 1909, **20,** 763.
7. Friedberger, E.: Ztschr. f. Immunitätsforsch., 1909-1910, Orig. **4,** 636.
8. Pepper and Krumbhaar: Jour. Infect. Dis., 1914, **14,** 476.
9. Lee and Vincent: Jour. Med. Research, 1915, **27,** 445.
10. Minot, G. R.: Personal communication.
11. Howell, W. H.: The Archives Int. Med., 1914, **13,** 76.
12. Minot, Denny and Davis: The Archives Int. Med., 1916, **17,** 101.
13. Hess, Alfred F.: Jour. Exper. Med., 1915, **21,** 338.
14. Lee and White: Am. Jour. Med. Sc., 1913, **145,** 495.

TABLE 1.—Effect of Horse Serum Injections on Blood of Normal and Anaphylactic Guinea-Pigs

Exper.	Date	Experimental Animal	Coagulation Time of Whole Blood		Prothrombin		Antithrombin (Hess Method)					
							Control		3 Drops Antithrombin		5 Drops Antithrombin	
			Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
1	3/ 3/16	Control	2	30	3	..	2	45	3	..	3	..
		Anaphylactic guinea-pig	6	..	9	..	..	..	6	30	9	..
2	3/13/16	Control	4	..	3	30	3	..	2	..	3	..
		Anaphylactic guinea-pig	16	30	14	..	..	..	6	..	6	..
3	3/15/16	Control	1	30	3	30	2	..	3	..	7	30
		Anaphylactic guinea-pig	21	..	19	30	..	..	9	30	15	..
4	3/24/16	Control	5	30	4	..	3	30	3	..	4	30
		Anaphylactic guinea-pig	12	..	14	30	..	..	3	30	3	30
5	3/26/16	Control	2	..	3	30	2	30	4	..	4	..
		Anaphylactic guinea-pig	9	30	8	..	..	..	7	..	9	30
6	4/ 3/16	Control	2	..	3	30	3	..	3	..	2	30
		Anaphylactic guinea-pig	39	30	24	30	..	..	7	..	9	30

A study of Table 1 shows that the coagulation time of the whole blood and the prothrombin time were uniformly delayed in the anaphylactic guinea-pigs. The determinations for antithrombin content were rather unsatisfactory and inconstant, as will be seen from the table, but there seemed to be a tendency to higher figures in the case of the anaphylactic blood. The unsatisfactory results may possibly be due to the fact that the Hess method is unsuitable for cases showing only slight variation in antithrombin content. Minot's[10] results in similar studies were essentially the same, though in some instances he succeeded in obtaining anaphylactic guinea-pig's blood that did not clot for hours; in one instance only after twenty-four.

Various findings accompanying the delayed coagulability of the blood in anaphylactic animals have been reported as possibly explaining the phenomenon. Sirensky,[15] in his work, reports that the fibrinogen and fibrin ferment were slightly decreased, while the calcium and magnesium content was unchanged. Conflicting reports occur as to the platelets. Achard and Aynaud[16] found an associated disappearance of platelets, while Biedl and Kraus[6] found the contrary. Some observers report a deficiency in the calcium content of the blood, but Pepper and Krumbhaar[8] report opposite findings. The latter attribute the delay in

15. Sirensky. Ztschr. f. Immunitätsforsch., 1910, **5,** 516.
16. Achard and Aynaud: Compt. rend. Soc. de biol., 1909, **67,** 83.

coagulation to an abnormally small amount of thromboplastin, or to an excess of antithrombin. In support of the former theory they point out that the addition of calcium and thromboplastin solution constantly produced a more rapid coagulation than any other method. Somewhat suggestive of the latter view, though rather unsatisfactorily so, are the author's and Minot's findings of a tendency to high antithrombin figures in anaphylactic animal blood.

Studies were also made in the coagulation factors of the blood in known anaphylactic conditions in man, namely, in cases of serum sickness. Von Witzinger[17] found in studying the effect of foreign serum injections in man on the coagulation of the blood, that the first injection was regularly followed by an acceleration of the coagulation, which subsided in twenty-four hours; also, that a second acceleration followed on the seventh, eighth, or tenth day after the injection, lasting a little longer than the first period. The reinjection of serum, however, was followed in five or six hours by a marked retardation of coagulation. This was most marked, he found, in cases in which the blood drawn directly from the vein was examined. His method of coagulation, however, can scarcely be said to be as accurate as those recently described, in view of the recent studies and theories of blood coagulation.

The author studied the coagulation time of the whole blood, the prothrombin time and antithrombin content in two cases of serum sickness following the injection of antipneumococcus serum in cases of lobar pneumonia, on the medical service of Dr. Longcope at the Presbyterian Hospital.

REPORT OF CASES

Case 1.—C. M., aged 38, merchant, was admitted March 18, 1916; discharged April 24, 1916. The diagnosis was lobar pneumonia. There was a history of cough and fever for four days before admission. Examination showed physical signs of consolidation of lower lobe of the left lung. Blood culture and sputum both showed pneumococcus, Group I. The patient received 80 c.c. antipneumococcus serum, Group I, with 80 c.c. sterile saline twice, March 19, 1916, and two similar doses of serum and saline, March 20, 1916. Serum sickness developed, beginning March 27, 1916, with extensive general urticaria, erythema, enlarged lymph nodes, swelling and puffiness of face and eyes, and joint pains. With his blood later passive anaphylaxis was transferred to guinea-pigs and his skin reacted positively to horse serum. March 24, 1916, coagulation time of the whole blood (Lee and White method) was 11 minutes; control, 9 minutes; prothrombin time, 10 minutes; control, 9 minutes. April 8, 1916 (10 days after onset of serum sickness), the coagulation time of the whole blood was 24 minutes; control, 7 minutes; prothrombin time, 21 minutes; control, 8½ minutes. May 29, 1916, the coagulation time of the whole blood was 14 minutes; control, 8 minutes; prothrombin time, 12½ minutes; control, 7½ minutes.

Case 2.—W. B., aged 38, was admitted Feb. 4, 1916; discharged March 10, 1916. Diagnosis, lobar pneumonia. There was a history of pain in the left side, with cough and fever for four days before admission. Examination showed

17. Von Witzinger, Oscar: Ztschr. f. Kinderh., 1911-1912, **3**, 211.

physical signs of consolidation of the left lower lobe. Blood culture was sterile. The sputum showed pneumococcus, Group I. The patient received 80 c.c. of antipneumococcus serum, Group I, with 80 c.c. sterile saline intravenously. Feb. 13, 1916, serum sickness developed; enlarged lymph nodes, joint pains, temperature, puffy face, diminished urine output and urticaria. Feb. 10, 1916, coagulation time of whole blood, 9 minutes; control, 9½ minutes; prothrombin time, 10 minutes; control 9 minutes. Feb. 16, 1916 (four days after development of serum sickness), coagulation time of whole blood, 18½ minutes; control, 6½ minutes; prothrombin time, 20 minutes; control, 9½ minutes. The patient was not obtained for further examination.

The tabulated results of these two cases appear in Table 2.

Turning now to the study of the coagulation factors in urticaria, the author studied the coagulation time of the whole blood, the prothrombin and antithrombin content, before and after treatment with

TABLE 2.—Results of Blood Examination in Cases 1 and 2 After Antipneumococcus Serum, Group I

Case	Date	Time of Examination	Coagulation Time of Whole Blood		Prothrombin		Antithrombin (Hess Method)					
							Control		3 Drops Antithrombin		5 Drops Antithrombin	
			Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
1. C. M.	3/24/16	3 days before serum sickness	11	..	10	..	9	30	10	..	10	..
		Control	9	..	9	..	..	..	9	30	11	..
	4/ 8/16	During serum sickness	24	..	21	..	8	30	10	30	10	30
		Control	7	..	8	30	..	..	10	..	11	30
	5/29/16	After serum sickness	14	..	12	30	8	..	8	..	9	30
		Control	8	..	7	30	..	..	8	30	8	30
2. W. B.	2/10/16	3 days before serum sickness	9	..	10	..	10	..	9	..	9	30
		Control	9	30	9	..	..	..	8	30	11	..
	2/16/16	During serum sickness	18	30	20	..	9	..	13	30	12	30
		Control	6	30	9	30	..	..	10	30	10	..

autogenous or heterogenous serum. Widal[5] and his co-workers report a condition of hypercoagulability of the blood in a case of chronic urticaria after the ingestion of animal proteins. Wright and Paramore,[18] however, report delayed coagulability of the blood in cases of urticaria, due, they believed, to a deficiency in calcium content. Nixon[19] found the blood coagulation time delayed in his cases of urticaria tuberosa of Willan, a condition closely related to ordinary urticaria. Minot,[10] in a study of three cases of severe urticaria, found the coagulation time of

18. Wright and Paramore: Lancet, London, 1905, **2**, 1096.
19. Nixon, J. A.: Quart. Jour. Med., 1916, **9**, 245.

the blood and the prothrombin time normal in two cases and delayed in one. The antithrombin factor he found to be normal. The histories of the cases studied by the author follow, and later is found a table of the results obtained in the coagulation factors of the blood both before and after the treatment with autogenous or heterogenous serum.

CASE 3.—L. M. S., nurse, aged 30, was seen first May 15, 1916, complaining of severe attacks of hives for six months. The family history was negative and revealed no asthma, urticaria or hay-fever. The patient's appetite was good; she took two cups of coffee and one of tea a day. She had been constipated for four years. She worked hard and was frequently under a great deal of nervous strain. Menstruation was normal. She had had typhoid fever and an operation for appendicitis; otherwise, she had always been well; no hay-fever or asthma. Three years previously she had had a slight attack of hives of unknown cause. Prior to her present attack she ate anything and everything and it alweys agreed with her. In December, 1915, while nursing at the American Hospital in France, the patient developed a severe attack of hives, with itching and burning, involving the arms, ankles, abdomen and chest. The patient said it followed the eating of some queer meat, either horse or cat, and that some of the other nurses had hives as well. The patient used sodium bicarbonate and calcium lactate without relief. She returned to the United States in January, 1916. The hives continued in very severe form until May 15, when first seen. Many remedies were tried, but nothing but epinephrin subcutaneously gave relief, and that only temporarily. The patient weighed 121 pounds. She was rather nervous. Physical examination showed a dry, rough skin, without petechiae, but with several urticarial spots on the arms and shoulders. There was a moderate dermographia. The color was good. Eyes, throat and teeth were normal. There were a few lymph nodes the size of peas in each posterior cervical chain. The lungs were clear and heart normal. Abdomen and extremities were negative. The blood pressure was 118-76. The blood showed: red blood cells, 4,800,000; hemoglobin, 85 per cent.; leukocytes, 9,600; polymorphs, 68 per cent.; lymphocytes, 32 per cent.; no eosinophils. The stool was soft, pasty, semiformed. Whole peas, cucumber seeds and spinach were easily recognized; no mucus, pus, or blood. Urobilin, slight; carbohydrate fermentation, slight; trypsin and amylopsin, normal. Microscopically: starch particles, much cellulose; no increase in the total fat; no mucus, pus, or blood; no ova or parasites; many muscle fibers, with round corners and few striations; gram-negative organisms about 60 per cent. of the total number. Skin tests, intradermic method, were carried out by Dr. Frank Rackermann. Horse, sheep, dog, milk, beef, egg, cat, pig, rabbit, ragweed and goldenrod all gave negative results. The patient's serum, tested with horse and rabbit serum in various dilutions, gave no evidence of precipitins. Guinea-pig blood, sensitive to rabbit and horse serum, treated with patient's serum gave no precipitins. Coagulation time of whole blood (Lee and White method), twenty minutes; control, eight minutes; prothrombin time, seventeen minutes; control, nine minutes. For antithrombin contents and complete blood findings, see Table 3. The patient was put on an anticonstipation diet, excluding meat, milk, fish, eggs and raw fruit; calcium lactate and epinephrin hypodermatically as needed for severe attacks. At first she improved rapidly on this régime, but she relapsed in a few days and had several severe attacks of hives, involving usually the arms, legs, back and face. One of the attacks she thought was caused by eggs and another by lobster.

As the condition was improving very little, it was decided to treat the patient with serum intravenously. Accordingly, she was given varying amounts of serum obtained from two members of the house staff of the Presbyterian Hospital after the customary tests for Wassermann reaction, hemolysis, agglutination, etc., had been made. The patient belonged to Group II.

May 25, 15 c.c. serum were given intravenously. There was no reaction. The patient had slight headache. There were a few hives on the ankle that evening.

June 4, the patient had been having some hives off and on since May 25, relieved by epinephrin. She was still constipated. She was given 20 c.c. serum intravenously. There was no reaction. She was put on a diet that excluded meats, but not chicken, fish, eggs, milk, cheese and fruits, and was given a proprietary laxative twice a day. Coagulation time of the whole blood, 14 minutes; control, 9 minutes; prothrombin time, 17 minutes; control, 11 minutes.

June 14, hives less; only a few at a time and itched less; given 15 c.c. serum intravenously; no reaction. Eggs were added to the diet by request.

June 22, had had several severe attacks of hives, most severe since beginning treatment. Eggs and chicken were stopped again; given 18 c.c. serum intravenously. No reaction.

June 25, very few hives. "Feels much better generally." Fourteen c.c. serum given intravenously.

June 29, no hives since June 24; 15 c.c. serum given intravenously. (Sixth and last dose.)

September 12, the patient returned from a vacation in the Adirondacks. She reported that she had an occasional attack of hives—only two or three at a time—until July 4, and after that none at all. "No real hives since June 18." After the beginning of July the patient felt perfectly well; her nerves were much better and the constipation was relieved; she ate anything and everything with impunity. Coagulation time of the whole blood, 10 minutes; control, 8 minutes; prothrombin time, 9 minutes; control, 9½ minutes.

Case 4.—J. S., aged 25, valet, was admitted to the Presbyterian Hospital March 1, 1916, complaining of headache and fever. Negative family history; no urticaria, eczema, asthma or hay-fever; had diphtheria at 6 and Neisser infection seven years prior to admission; otherwise he had been well. In January, 1916, the patient ate lobster salad while in Nassau-off-Florida, and during the following twenty-four hours had severe abdominal cramps, diarrhea and vomiting; also extensive eruption of hives involving face, abdomen, back and legs, and accompanied by unbearable itching. The gastro-intestinal symptoms subsided after twenty-four hours, but the hives continued off and on until admission. On admission he had a severe headache, felt weak and prostrated, and had had a severe eruption of hives for twenty-four hours. His temperature was 102 F., pulse 88, respirations 18. His appearance was that of the early stage of typhoid fever. The physical examination was negative, except for moderate enlargement of the inguinal and posterior cervical lymph nodes on both sides. Blood pressure, 124-80; weight, 108 pounds; blood culture was sterile; von Pirquet, negative; blood count showed leukocytes, on admission, 13,000, with 80 per cent. polynuclears, 20 per cent. lymphocytes; no eosinophils. Three days later when the temperature came down to normal the leukocytes were 5,200, with 54 per cent. polynuclears and 46 per cent. lymphocytes; no eosinophils. Lumbar puncture yielded negatives results. During his stay in the hospital the patient continued to have an extensive urticarial eruption, with occasional joint pains. He left the hospital after three days fully recovered except for the urticaria, which continued.

March 18, after leaving the hospital the patient was quite well except that the urticaria persisted. Coagulation time of the whole blood (Lee and White method), 14 minutes; control, 10 minutes; prothrombin time, 11 minutes; control, 11½ minutes.

April 5, had had joint pains from time to time and urticaria had been most severe of late, interfering with his sleep during the previous four nights. He was put on a strictly vegetarian diet; no meat, eggs, milk, cheese or fish. Serum treatment was started. Between April 14 and June 20 the patient received six doses of autogenous serum; the amount of each dose was from 12 c.c. to 20 c.c.

No reaction occurred. Autogenous serum was used because of difficulty in securing a regular donor, and because it seemed desirable to see if autogenous serum had the same effect as serum from other persons. During this time the patient had some joint pain and a varying amount of urticaria, until after the third dose of serum, May 25. After that he had no hives, and only occasional joint pain, until June 1; after that none. The patient was last seen Oct. 14, 1916. He had been perfectly well since June 1; no urticaria and no joint pains. Coagulation time of whole blood, 9½ minutes; control, 7 minutes; prothrombin time, 10 minutes; control, 10⅓ minutes. See Table 3.

Case 5.—K. H., aged 17, woman, clerk, was first seen at the Presbyterian Dispensary, Sept. 16, 1915, complaining of indigestion and skin trouble lasting for six months. Negative family history; no urticaria, eczema, asthma, or hay-fever. She had had measles, diphtheria in 1914, and had received two doses of antitoxin. She says she had difficulty in breathing after antitoxin. She slept well and had a good appetite. Menstruation was normal and easy. Six months previously the patient began to have urticaria, with intense itching and dermographia. The urticaria was general and constant when first seen, worse she thought, after eating eggs or meat. She was troubled considerably with stomach gas. The bowels were regular and urination normal. She was well developed and had a good color. The tongue was coated. Throat, heart, lungs and abdomen were negative. There was extensive urticarial eruption over the back, legs, abdomen and neck. The eyes and lips were not involved. She was put on a diet excluding meat and eggs, without benefit.

September 21, intradermic skin tests for sensitization were made by Dr. Rackermann. She gave a slight, though definite, reaction to horse serum; others were negative.

January 18, the urticaria had improved at times, then returned as severely as before. She had become discouraged about dieting and now ate what she pleased. Calcium lactate had no effect. She was relieved temporarily by epinephrin. The blood pressure was 110-76; red blood corpuscles, 4,600,000; hemoglobin, 88 per cent.; leukocytes, 9,600; polymorphs, 70 per cent.; lymphocytes, 28 per cent.; eosinophils, 2 per cent., and the coagulation time of the whole blood was 18 minutes; control, 9 minutes; prothrombin time, 18⅓ minutes; control, 7½ minutes.

February 6, the patient received 15 c.c. of autogenous serum, without immediate reaction. The patient could not be reached after this visit.

Case 6.—E. D., aged 29, maid, was admitted to the medical service of the Presbyterian Hospital, June 24, 1916, where she remained, with short leaves, until Oct. 2, 1916. She complained of hives and swelling of her face for the previous three months. Family history negative; no asthma, hay-fever or eczema. As a child, she had had measles, scarlet fever and diphtheria without antitoxin. Her tonsils were removed fifteen years previously. She had had a slight attack of rheumatism five years previously. Her appetite was good, bowels regular, urination normal and habits good. She had always been nervous. Three months prior to admission she had had a severe gastro-intestinal attack, with nausea, vomiting and diarrhea, lasting twelve hours. The next morning her eyes and lips were puffy and she had some hives. Since then until admission she had had recurrring swellings of her face, with severe urticaria, itching intolerably. She had "tried everything" without relief. Examination showed nothing abnormal except extensive urticaria and swollen eyelids and lips. The blood pressure was 126-80; urine, negative; hemoglobin, 90 per cent.; leukocytes, 7,000; polymorphs, 67 per cent.; lymphocytes, 33 per cent.; no eosinophils; weight, 111 pounds.

June 26, prothrombin time, 17 minutes; control, 8 minutes; coagulation time of whole blood, 14 minutes; control, 6 minutes. While in the hospital she had a curettage for a chronic leucorrhea. During this time she received four doses of heterogeneous human serum intravenously, each dose averaging 15 c.c.

August 25, patient returned to the hospital, having had an acute gastro-intestinal upset three days previously, and reporting that the hives and facial swellings were still as bad as ever. She was tried out with various dietetic restrictions, calcium lactate, epinephrin and atropin and colon irrigations—all without the slightest effect. Skin tests for sensitization to foreign proteins were always unsatisfactory, as the patient was continually having urticaria, which made the readings worthless. She received four doses of her own serum, 20 c.c. at a time. September 9, her coagulation time (whole blood) was 12½ minutes; control, 9 minutes; prothrombin time, 13 minutes; control. 10 minutes. The patient was seen in the dispensary at two-week intervals until December 1, and reported absolutely no improvement.

TABLE 3.—Results on Blood with Heterogeneous and Autogenous Serum

Patient	Date		Coagulation Time of Whole Blood		Prothrombin		Antithrombin (Hess Method)					
							Control		3 Drops Antithrombin		5 Drops Antithrombin	
			Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
3. L.M.S.	4/19/16	No treatment with serum	20	..	17	..	7	..	6	30	9	30
		Control.....	8	..	9	..	..	..	7	..	7	30
	5/29/16	2 doses serum...	18	..	14	..	8	30	9	..	14	30
		Control.....	10	..	7	..	..	..	10	30	11	..
	9/12/16	After 6 doses serum	10	..	9	..	10	30	8	..	10	..
		Control.....	8	..	9	30	..	..	10	..	11	30
4. J. S.	4/14/16	No treatment...	14	..	11	..	10	..	12	..	11	30
		Control.....	10	..	11	30	..	..	10	..	11	..
	10/14/16	After 6 doses serum	9	30	10	..	7	..	7	30	8	30
		Control.....	7	..	10	30	..	..	7	..	8	..
5. K. H.	1/18/16.....		18	..	18	30	..	..	..	..	..	..
		Control.....	5	..	7	30	..	..	..	..	..	..
6. E. D.	6/26/16.....		14	..	17	..	..	..	..	..	..	..
		Control.....	6	..	8	..	..	..	..	..	..	..
	9/ 9/16.....		12	30	13	..	..	..	..	..	..	..
		Control.....	9	..	10	..	..	..	..	..	..	..
7. J. I.	9/21/16.....		14	..	15	30	9	..	8	30	9	..
		Control.....	10	..	9	..	..	..	9	..	10	30
	11/ 2/16	After serum.....	12	..	10	..	..	..	..	..	..	..
		Control.....	9	..	10	..	..	..	..	..	..	..

Case 7.—Mrs. J. I., aged 30, teacher, was admitted to the Presbyterian Hospital, Sept. 1, 1916; discharged Sept. 30, 1916. Diagnosis, angioneurotic edema and urticaria. Her complaint was hives and facial swellings for six weeks. The family history was negative for urticaria, eczema, asthma and hay-fever. She had had the usual children's diseases, including diphtheria, without antitoxin. Two years prior to admission both ovaries were removed for cysts, and she had been troubled with hot flushes and headaches since then. She tired easily; appetite was good; bowels regular; urination normal. She had had no children; no miscarriages. Fifteen years prior to admission the patient had an attack of angioneurotic edema and urticaria like the present attack; it lasted for two years, and she had no further trouble until the present attack. For

20. Kahn and Emsheimer: The Archives Int. Med., 1916, **18**, 445.

one month the patient had had swellings of lips and eyes and severe general urticaria, not influenced by dieting or medication. During the previous two weeks the patient had noticed small black and blue spots over her thighs and legs. She was well nourished and quite nervous. The left eye was swollen almost shut and she had some urticarial wheels scattered over back and abdomen. There were a few purpuric spots scattered over her thighs and legs. Otherwise, the examination showed nothing abnormal. The hemoglobin was 86 per cent.; leukocytes, 6,600; polymorphs, 66 per cent.; lymphocytes, 34 per cent.; no eosinophils. Coagulation time of whole blood, 14 minutes; control, 9½ minutes; prothrombin time, 13½ minutes; control, 8 minutes . She was given a diet without fish, milk, eggs, meat or cheese, and calcium lactate. She rapidly improved, but thought that when lamb chops were later added she became worse. During her stay in the hospital she was given two doses of autogenous serum (20 c.c. each). Intracutaneous tests for sensitization showed positive reaction to phaseolin (beans), beef and pig. She was put on a diet that excluded these articles and discharged. Following her discharge she improved markedly, had no swellings of her face and "the hives had been much better." She had one severe attack after eating beef, but ate pork with impunity.

November 2, coagulation time of whole blood, 12 minutes; control, 9 minutes; prothrombin time, 10 minutes; control, 10 minutes.

Nothing was found to explain why the delayed coagulation time of the whole blood and the delayed prothrombin time disappeared with an approach to normal figures in three out of the four cases of urticaria treated with serum. If, as some[20] think, by the introduction of autogenous defibrinated blood or blood serum an appropriate antigen is introduced to create the appropriate antibodies for the production of active immunization, then it is possible that the anaphylactic state is overcome, and hence the coagulation factors of the blood change to normal. But, as we are dealing with so complex and so little understood a substance as blood serum, no definite conclusion can be reached.

The author is not prepared to assert anything at this time as to the therapeutic value of human serum in clinical anaphylaxis in man. This problem is now being investigated, and the results will be reported at another time.

SUMMARY

1. Studies with anaphylactic guinea-pig's blood showed a delay in the coagulation time of the whole blood and in the prothrombin time. Determinations of antithrombin content were inconstant and unsatisfactory, but there seemed to be a tendency to higher figures in the case of the anaphylactic blood.

2. Studies with the blood of patients suffering from serum sickness showed a marked delay in the coagulation time of the whole blood, and of the prothrombin time during the serum sickness, with a later fall to nearly, but not entirely, normal figures for both after the disappearance of the serum sickness. The results with the antithrombin content were inconclusive.

3. Studies of the blood of patients suffering with chronic urticaria showed a delayed coagulation time and prothrombin time in four out of five cases, with an approach to normal figures after the patients had been treated intravenously with autogenous or heterogenous serum in three cases out of four.

The funds necessary to carry out the foregoing study were supplied by Mrs. Arthur W. Swann, in memory of the late Dr. Arthur W. Swann. I wish to thank Dr. W. G. McCallum, Dr. Warfield T. Longcope and Dr. Albert R. Lamb for their constant assistance and cooperation.

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EMETIN DIARRHEA—CLINICAL AND EXPERIMENTAL

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It is well known that, in large doses, emetin hydrochlorid gives rise to a hemorrhagic gastro-enteritis in experimental animals. That it produces a bloody diarrhea not rarely in the course of its clinical use is coming to be recognized, though in an exhaustive review of the literature published last year[1] only seven cases were collected. A number of unpublished cases occurring in China have come to our attention through personal communications. It seems to us to present a real danger, well worth more discussion that it has received.

The difficulty in the recognition of diarrhea from emetin, as well as its danger, is due to the fact that it occurs in the course of treatment for amebic dysentery and that the symptoms and the gross appearance of the stools in emetin diarrhea are almost indistinguishable from those in amebic dysentery. The patient receives daily doses of emetin and for a few days improves and the amebas disappear from the stools, which become more or less normal. Then the diarrhea becomes worse, with reappearance of blood and mucus in the stools. Mistaking this condition for a relapse of the dysentery, the emetin is pushed, which only increases the diarrhea, and if the condition is not recognized serious results may easily follow.

The following case reports will perhaps best illustrate the condition. They were all cases in private practice or seen in consultation by one of us.

REPORT OF CASES

CASE 1.—A boy of 6 began to have bloody diarrhea while on a Yangtze River steamer, so that his stools were not examined microscopically. They had the gross appearance, however, of amebic dysentery stools and he was given emetin in 15 mg. (¼ gr.) daily subcutaneous doses for two days, and then one dose of 30 mg. (½ gr.). The stools decreased to one or two a day and were fairly normal in appearance. On the fourth day he was given 65 mg. (1 gr.), and the following day had a return of his diarrhea—five stools with blood and mucus; no amebas found. The emetin was stopped and he began to improve at once, was well within a week and had remained well when last reported five weeks later.

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* From the Harvard Medical School in China and the Red Cross General Hospital.

1. Levy and Rowntree: On the Toxicity of Various Commercial Preparations of Emetin Hydrochlorid, THE ARCHIVES INT. MED., 1916, **17,** 420.

CASE 2.—A boy of 18 months had a typical bloody diarrhea, but amebas were not recognized with certainty (in a cold specimen). He was given emetin 20 mg. (⅓ gr.) a day for five days, with marked improvement during the first three days, in the frequency and character of the stools, though they did not become quite normal. On the fourth day the diarrhea was worse, and on the fifth day still worse, with stools every half hour consisting almost entirely of blood and mucus and passed with evident pain. No emetin was given after the fifth day. Improvement began at once and within four days the diarrhea had practically ceased. Six months later he had had no recurrence.

CASE 3.—A Chinese boy of 10 had bloody diarrhea with amebas in the stools. He was seen by two Chinese Western-trained practitioners and was given injections of emetin amounting to 450 mg. (7 gr.) in the course of six days. At the end of this time he was getting very much worse and was passing stools two or three times an hour. There was great prostration and a continued fever of 102 to 104 F. The stools consisted entirely of blood, pus and mucus, apparently not at all different from those passed before treatment was begun, except that no amebas were found. Consultation with one of us resulted in the diagnosis of emetin diarrhea and the discontinuance of the emetin. The patient began to improve at once and with administration of bismuth by mouth and tannic acid irrigations per rectum, he recovered completely in the course of ten days.

It may be noted that this last case differs from the others in that there was no temporary improvement after the first two or three injections of emetin. We attribute this to the fact that the dosage was so overwhelmingly large that the emetin diarrhea was already started before the amebas had disappeared.

In only the last case was any change in the dietary or other treatment made when the emetin was discontinued. The last patient was in such bad condition that tannic acid irrigations were given.

Only one case of human emetin poisoning has come to necropsy and been reported — that of Levy and Rowntree[1] — and in this case there had been no diarrhea for five days before death, the gastro-intestinal tract showing only a "slight flushing of the mucosa" in the lower part of the ileum. We have seen one fatal case — a child of 18 months — in which there was, first, improvement with disappearance of amebas from the stools, later increase in the diarrhea. The emetin was pushed instead of stopped and the case went on to fatal termination. This case is not included in our list of reported cases because it was impossible to secure a necropsy and prove the diagnosis. We hope not to have opportunity to secure a human necropsy on this condition and are therefore dependent on experimental animals for a study of its pathology.

EXPERIMENTS

Hemorrhagic gastro-enteritis has been produced in dogs with emetin by a number of investigators.[2] Our experiments were under-

2. Levy and Rowntree: See Footnote 1. Dale: A Preliminary Note on Chronic Poisoning with Emetin, Brit. Med. Jour., Dec. 18, 1915, p. 895. Pellini and Wallace: Pharmacology of Emetin, Am. Jour. Med. Sc., 1916, **152**, 325.

taken primarily in an effort to produce peripheral neuritis[3] rather than gastro-enteritis, but they have furnished an opportunity to corroborate, and perhaps to extend somewhat, the observations published by others on the latter condition.

Thirty dogs were used in the experiments on peripheral neuritis. A somewhat more detailed study of the gross and microscopic necropsy findings on the first thirteen of these dogs forms the basis of this report.

Of these thirteen dogs, eleven were given emetin and two were kept in adjoining kennels on the same food as controls. The doses of emetin given varied from 1 to 8 mg. per kilo of body weight —averaging 2 to 2.5 mg. per kilo. The doses were all given subcutaneously, daily or every other day.[4]

There was considerable variation in the number and size of the doses required to kill the animals. The symptoms shown and the pathologic findings depended on this factor of individual variation more than on the size and number of doses.

Typically, after several doses, the animals gradually became listless, then began to refuse food and to show signs of increasing weakness, progressing to death. Death frequently occurred from three to six days after the last dose of emetin had been given. In fact, only one dog recovered after the development of definite symptoms, even though the emetin was discontinued at once.

Nine of the eleven dogs that died from emetin were observed to have bloody stools, or showed bloody fluid in the gastro-intestinal tract at necropsy. Only three were known to vomit, the vomitus in one instance containing a small amount of blood (by guaiac test).

PATHOLOGY

The *pathology* was that of hemorrhage throughout. The distribution and extent varied somewhat, but little else of significance was found.

The *peritoneum* in one case showed hemorrhagic infiltration of both parietal and visceral layers ventrally over an area half the size

3. These experiments were stimulated by the observation of a number of cases of peripheral neuritis seen in human beings and reported by one of us (Kilgore, A. R.: Peripheral Neuritis Following Emetin Treatment of Amebic Dysentery, Boston Med. and Surg. Jour., 1916, **175,** 380). Observations on the peripheral neuritis produced in dogs will be published in a separate communication.

4. A dose of 2 mg. per kilo for a man of 65 kilos (143 pounds) would be 130 mg. (2 gr.). This is perhaps the upper limit of the doses usually given clinically. The preparation used in all the experiments was Parke, Davis & Co.'s hypodermic tablets.

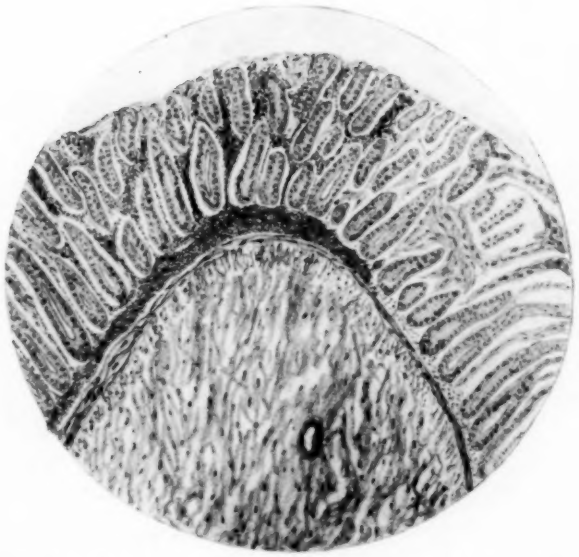

Fig. 1.—Intestine, showing the characteristic location of hemorrhages at the tip of a fold, and the superficial distribution in, as well as under, the mucosa.

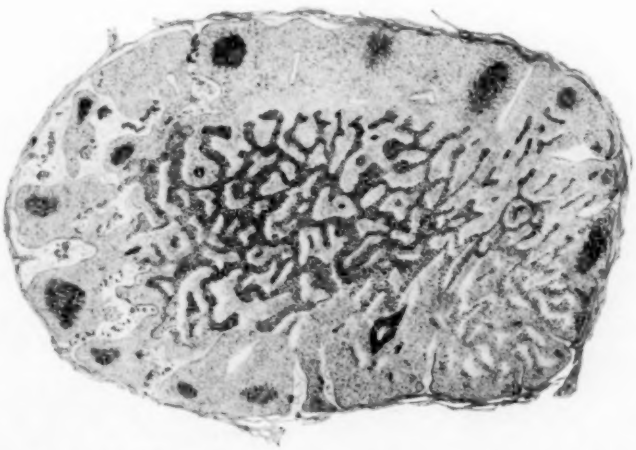

Fig. 2.—Mesenteric lymph node, showing hemorrhage filling the lymph sinuses in the center of the node.

Fig. 3.—Spleen, showing the characteristic distribution of the hemorrhage, in this instance almost entirely confined to the region just under the capsule.

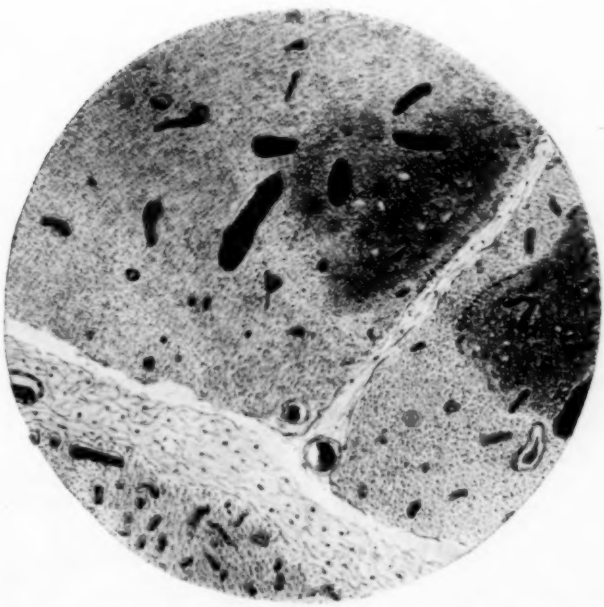

Fig. 4.—Thymus, showing general congestion of the blood vessels, and two localized clotted hemorrhages.

of one's palm. Another case showed many bright petechiae over the surface of the lower large bowel.

The *gastro-intestinal tract* typically contained more or less bloody fluid and mucus, sometimes in the upper and sometimes in the lower part of the tract. In two instances the intestine was nearly filled with dark red fluid from the stomach to the rectum. All the dogs showed submucous hemorrhages of varying character and distribution, with a tendency to be most marked in the upper small bowel and also in the first part of the colon. In one dog the mucous membrane was lifted off the submucosa in two places by hemorrhages 3 to 4 mm. in diameter. The typical lesions, however, were petechiae, commonest in the duodenum and upper jejunum and in the proximal colon, but often extending from the pyloric half of the stomach to the rectum. The petechiae tended to pick out the tips of the folds of mucous membrane, giving a very curious striated appearance, and in three instances the edge of the ileo-cecal valve was crowded with petechiae. Microscopically, the hemorrhages were found to be very superficial, occurring not only under the mucosa, but in it between the gland tubules (Fig. 1).

In several of the dogs a varying number of punched-out depressions, 4 to 6 mm. in diameter, with smooth, rather convex bases, were found in the mucosa chiefly of the upper small bowel. These were also found in the normal control dogs and were seen microscopically to be lymphoid patches. In two of the emetin dogs several of these were hemorrhagic. In some descriptions "ulcers" have been mentioned, corresponding in appearance and distribution very closely with these lymphoid patches. No true ulcers were observed in any of the dogs in this series.

The *mesenteric glands* in all the dogs, including the controls were very large, up to 2 or 3 cm. in length and 5 to 10 mm. thick. They usually showed on cross section brownish centers and white peripheries (of lymph follicles). In seven of the eleven emetin dogs, the mesenteric glands exuded blood on section and in two dogs similar popliteal glands were found.

Microscopically, the hemorrhages were found to be confined chiefly to the lymph sinuses. The cortices together with the lymph follicles showed no changes in structure from those in the control dogs. The lymph spaces showed abundant collections of blood, in most cases quite fresh, which, staining a bright red, stood in striking contrast to the blue-staining medullary cords which are surrounded by them (Fig. 2). In a few cases in which there had been hemorrhage apparently some time before death, the lymph sinuses contained large numbers of endothelial leukocytes, many of which showed their phagocytic nature by the incorporation of red blood corpuscles or blood pigment.

The *liver* was in a few instances quite congested both grossly and microscopically, the congestion of the sinusoids showing no characteristic distribution with reference to the lobules. Petechiae under the peritoneal surface of the liver were found, confined to small areas, in one instance.

The *spleen* showed hemorrhages in all of the emetin dogs. It is very hard to say whether there was increase in the size of the organ, but there was apparently congestion in each case. The consistence of all the spleens, including the controls, was rather firm, but the ones which showed the most hemorrhage were softer. Microscopically, the hemorrhages were found in all parts of the pulp, but the periphery was spared in only two cases, and in six the hemorrhage was most prominent or entirely confined to this region (Fig. 3). The splenic corpuscles showed nothing pathologic in themselves, but were sometimes encroached on by hemorrhages. In cases in which the hemorrhage had apparently existed for some time there was a great increase in the number of phagocytic endothelial leukocytes and a concomitant proliferation of the connective tissue cells of the reticulum. Lymphocytes were comparatively scarce in all the spleens except in the vicinity of and forming the splenic corpuscles.

The *kidneys* showed a moderate degree of congestion in most cases and occasional small hemorrhages in the medulla. The glomeruli and tubules were not markedly affected.

The *pancreas, adrenals, lungs* and *heart* showed nothing of note.

In two young dogs the *thymus* was found to be of large size, purple in color and dripping blood on section. In one of these and in one other dog petechiae were found in the fat of the anterior mediastinum. A section of thymus is shown in Fig. 4.

The nervous system showed no obvious lesions.

SUMMARY

Three cases are reported in which the diagnosis of emetin diarrhea, produced in the course of treatment for amebic dysentery, is reasonably certain. Recovery was prompt on discontinuing the emetin. The authors have seen a fourth case, terminating fatally, in which the same diagnosis was made, but have not reported this case in detail on account of failure to secure a necropsy.

All of these cases were in children and all had received doses considerably larger than would be proportionate on a basis of 65 mg. (1 gr.) for an adult. This fact is especially interesting in view of the opinion not infrequently held that children are more resistant to emetin than adults. It is our present practice to give doses of 65 mg. (subcutaneously or intravenously) to adults and to graduate doses for chil-

dren proportionately, watching carefully for any increase in the diarrhea which might be due to emetin.

Experiments of others and those reported here furnish abundant evidence of the tendency of emetin to produce in dogs a hemorrhagic gastro-enteritis with hemorrhages in the lymph glands, spleen, kidneys, thymus, etc., ultimately resulting in death, even if the emetin be stopped as soon as definite symptoms are observed.

STUDIES ON THE OXIDASE REACTION OF THE CELLS IN NORMAL AND LEUKEMIC BLOOD*

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The oxidase reaction is considered specific for the myeloid series of cells (polymorphonuclears, myelocytes and myeloblasts) and its performance is briefly summarized as follows: A normal blood smear is fixed in formaldehyd vapor and then flooded with a mixture of alphanaphthol (1 per cent.) and dimethylparaphenylenediamin (1 per cent.) for a few minutes. On examination the smear will show the presence of blue granules in the polymorphonuclear cells and no granules in the lymphocytes. The blue granules are supposed to be due to the synthesis of indophenol blue from the oxidation of alphanaphthol and dimethylparaphenylenediamin, the condensation of the molecules being effected by an oxidizing ferment or oxidase, which is present in the premature and mature bone marrow cells.

During the course of an investigation of the classification of the leukocytes in normal and abnormal blood I have had occasion to perform the oxidase reaction for the demonstration of the oxidase granules in the various types of blood cells, both in normal and leukemic blood. The occurrence of these granules in the myeloid series of cells has become an important method of distinguishing between the lymphoid and myeloid types of leukemia, especially when the character of the mononucleated cells is difficult to determine with polychromatic staining. The reaction is also considered of great importance in view of the fact that conflicting statements exist concerning the reaction on certain blood cells, which may possibly be lymphoid or histogenous in origin, and that certain definite myeloid cells fail to show the oxidase granules.

The history and theories of the oxidase reaction have been well reviewed by Loele[1] and Battelli and Stern,[2] to whom the reader is referred for interesting information concerning the oxidative phenomena of the cells. It is my purpose to give only a summary of the various theories and the important methods of the microchemical demonstration of the oxidizing ferments of the blood cells.

The two main oxidizing ferments of the blood cells are the oxidases and the peroxidases. The former can break up oxygen (O_2) into

* Submitted for publication April 6, 1917.
* From the Pathological Laboratory, Mount Sinai Hospital.
1. Loele, W.: Ergebn. d. allg. Path., 1913, **16**, 760.
2. Battelli and Stern: Ergebn. d. Physiol., 1912, **12**, 96.

nascent oxygen (O) in order to oxidize a substance, and the latter is capable of breaking up hydrogen peroxid into water and nascent oxygen, which becomes available for oxidative processes. The true nature of these ferments is still unknown, and it is problematical whether the oxidase and peroxidase reaction of the blood is due to the action of a ferment or to a biochemical side chain.

According to Loele,[1] the oxidases or oxidase granules can be shown in the blood cells in three ways:

A. Acceleration of a dye synthesis, by an oxidative process within the cell.

B. The acceleration of dye formation outside of the cell by means of an intracellular oxidative substance.

C. Oxidation of a reduced dye such as methylene white.

A. Acceleration of a Dye Synthesis, by an Oxidative Process Within the Cell.—This depends, according to Loele, on a phenol reaction, or polyphenoloxidase, according to Battelli and Stern.[2] The cellular granules in this reaction appear as yellow, brown, violet or black, or the cytoplasm may show a diffuse coloration. Various phenols such as epinephrin, resorcin, alphanaphthol, pyrogallol, etc., in weak alkaline solution, are oxidized in this manner.

Three important methods are used in such oxidase reactions, as follows:

1. The epinephrin reaction of Kreibich.[3] The oxidase granules of the blood are stained by epinephrin (1-1,000).

2. Alphanaphthol-gentian-violet method of Loele.[4] Beautiful and relatively permanent preparations are obtained by this method, but it does not show as many oxidase cells are some of the other methods cited.

3. Alphanaphthol-pyronin method of Graham.[5] This method was carefully studied in comparison with other methods and was found to be excellent. The details of the procedure will be described later. The method depends on the use of hydrogen peroxid and may possibly be an indicator of peroxidases. The reaction also depends on the acidophilic properties of the granules, since I have found that the reaction is not obtained in basophil cells.

B. The Acceleration of Dye Formation Outside of the Cell by Means of an Intracellular Oxidative Substance.—The indophenol-blue synthesis from the oxidation of alphanaphthol and dimethylparaphenylenediamin is an example of this reaction. This was first used by

3. Kreibich, C.: Wien. klin. Wchnschr., 1910, **23,** 701.
4. Loele, W.: Folia haemat., 1914, **18,** 581.
5. Graham, C. S.: Jour. Med. Research, 1916, **35,** 231.

Ehrlich[6] who injected a mixture of alphanaphthol and paraphenylenediamin intravenously and noticed a marked indophenol-blue coloration of the brain, heart and diaphragm, but very little indophenol in the liver, muscles and kidneys. The blood did not show any indolphenol. Röhman and Spitzer[7] (after whom the indophenol reaction is named) found that indophenol is produced from a mixture of alphanaphthol and paraphenylenediamin when exposed to the air, but the reaction is hastened when macerated liver is added to the reagents. Winkler[8] used the alphanaphthol-paraphenylenediamin reaction on gonorrheal smears and found that such smears become blue. He attributed an oxidase reaction to both myeloid and lymphoid cells, and also to erythrocytes in anemia. Schultze[9] introduced this reaction for tissue sections and blood smears as a diagnostic method for the recognition of myeloid leukemias, and found that only myeloid cells react to the alphanaphthol and dimethylparaphenylenediamin. Previous to the introduction of the indophenol reaction, the guaiac reaction (Brandenburg,[10] Meyer and Heineke[11]) was used to a large extent. The serum of myeloid leukemias oxidizes guaiac to a blue color even without the presence of hydrogen peroxid; normal and lymphoid leukemic serums do not oxidize it. Klein,[12] however, called attention to certain lymphatic leukemias which give the characteristic guaiac reaction.

METHODS

The most important methods of carrying out the indophenol or oxidase reaction are as follows. Most of the authors recommend formaldehyd vapor as a fixative.

I. The three methods of Schultze:[13]

A. 1. Alphanaphthol (1 per cent. boiled in water and sufficient potassium hydroxid added to dissolve it).

2. Dimethylparaphenylenediamin, 1 per cent. According to Pappenheim and Nakano,[14] this is good for eosinophils, but his following two methods are preferable for polynuclear neutrophils. Winkler[8] uses sodium carbonate instead of potassium hydroxid.

B. 1. Mikrocidin (Betanaphthol sodium), 2 per cent.

2. Dimethylparaphenylenediamin hydrochlorid, 1 per cent.

C. 1. Alphanaphthol as in *A*.

2. Paranitrosodimethylanilin, 1 per cent.

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6. Ehrlich, P.: Das Sourstoffnedurfuis des Organismus, Berlin, 1885.
7. Röhman and Spitzer: Chem. Ber., 1895, **28,** 567.
8. Winkler, F.: Folia haemat., 1907, **4,** 323.
9. Schultze, W. H.: Beitr. z. path. Anat. u. z. allg. Path. (Ziegler's), 1909, **45,** 127.
10. Brandenburg, K.: München. med. Wchnschr., 1900, **42,** 183.
11. Meyer, E., and Heineke: München. med. Wchnschr., 1903, **52,** 1489.
12. Klein, Stanislaus: Folia haemat., 1904, **1,** 71.
13. Schultze, W. H.: München. med. Wchnschr., 1909, **56,** 167; 1910, **57,** 2171.
14. Pappenheim and Nakano: Folia haemat., 1912, **14,** 260. Nakano, J.: Folia haemat., 1913, **15,** 123.

The solutions of *A* need not be fresh and are used in succession, but the *B* and *C* solutions must be freshly prepared and mixed before they are applied to the blood smear.

II. Von Gierke's method:[15]

Both reagents (Schultze's method *A*) are dissolved in physiologic saline solution. Pappenheim and Nakano[16] consider it a good stain for neutrophilic granules, especially after osmic acid fixation. Von Gierke, using his method on fresh tissue, identifies more oxidase cells than those found in tissues fixed with formaldehyd. The additional cells are due to labile oxidases, which are destroyed by formaldehyd.

III. Fiessinger and Rudowska's[16] method:

Alphanaphthol, 1 to 4,000.

Dimethylparaphenylenediamin, 1 to 1,000.

This proves to be economical in the use of reagents and adequate for the rapid differentiation and rough estimate of the number of oxidase cells present in the blood smear.

IV. Dunn's[17] method:

Fix in osmic acid, 1 per cent., five seconds.
Wash in running water five minutes.
Flood slide for five minutes with a mixture of equal parts of alphanaphthol, sat aq. sol., and dimethylparaphenylenediamin, 0.20 per cent. aq. sol.

The method is excellent. The slide can be directly examined with the oil immersion lens, but the granules begin to fade within one-half hour. The method, however, often fails to show granules in myeloblasts when these can be identified with other methods.

V. Pappenheim's method. The steps of the procedure will be described later.

C. Oxidation of a Reduced Dye Such as Methylene White.—This method was applied by Unna[18] to demonstrate oxidizing substances. The main sources of the oxidases with this method are the nuclei and basophil particles; lipoids react after treatment with formaldehyd.

The nature of the oxidizing substance is still unknown. The various reactions for the demonstration of these oxidizing substances depend on receptors in the cells, which are able to fix the oxidized or synthetized coloring material. The receptors must possess a surplus of oxidases, for it has been shown that reductases are also present in the cell (Schultze,[13] Unna[19]). The presence of both reductases and oxidases in well balanced proportions probably accounts for the failure of certain structures to stain with the synthetized color reagents. Schultze and Winkler consider the oxidizing substance of the cell to be a ferment (oxidase or peroxidase); Dietrich[20] believes that the reaction

15. Von Gierke, E.: München. med. Wchnschr., 1911, **57,** 2171.
16. Fiessinger, N., and Rudowska, L.: Arch. de méd. exper. et d'anat. Path., 1912, **24,** 585.
17. Dunn, J. S.: Jour. Path. and Bacteriol., 1911, **15,** 20; Quart. Jour. Med., 1913, **6,** 293.
18. Unna, P. G.: Arch. f. mikr. Anat., 1911, **78.**
19. Unna, P. G., and Golodetz, C.: Dermat. Studien, 1912, **22.**
20. Dietrich, A.: Zentralbl. f. Path., 1908, **19,** 3.

depends on the lipoids. Herxheimer[21] recommends indophenol in 70 per cent. alcohol as an excellent blue stain for fat. Ikeda[22] found that the granules of the cells of the submaxiliary gland, which show a distinct oxidase reaction, also stained by Smith's method for fat. Neutrophilic granules, however, after prolonged treatment with alcohol, ether and chloroform can still show a marked oxidase reaction. It is possible that the oxidase reaction of the endothelial cells (Ikeda[22]), the transitionals and the large mononuclears, depends on lipoidal particles which often cannot be identified with the ordinary blood stains. Loele attributes the reaction to a phenophil substance in the cell.

The different methods advocated for blood films were investigated, but most of them proved inadequate for the study of the types of cells involved in the reaction. Some of the methods also proved to be inconstant and often failed to work. The Pappenheim and Loele and Graham methods proved to be excellent for routine work. The cells, by employing these methods, could be examined directly through cedar oil (obviating the use of cover glasses). Another advantage is the fact that the solutions for use in the reaction need not be freshly prepared. Fixation with osmic acid (1 per cent.), alcohol (95 per cent.), or, preferably, alcohol-formaldehyd (9 to 1), did not interfere with the oxidase reaction (Dunn,[17] Graham[5]), but, on the contrary, intensified it (Klopfer[23]). The Loele method failed to identify as many oxidase cells as Pappenheim's or Dunn's methods (similar to the experience of Pappenheim and Nakano), and the method of Graham was substituted for it.

The Pappenheim method gave reliable results, and, furthermore, proved to be extremely advantageous for the study of the cells with the oil immersion lens. The following is a schematic outline of the method employed:

Pappenheim's Method (Author's Modification):

1. Fix with alcohol (95 per cent.), formaldehyd (40 per cent.), (9 parts of the former to 1 part of the latter) two minutes. Formaldehyd solution alone or osmic acid (1 per cent.), as in Dunn's method, can also be used.
2. Alphanaphthol 1.0
   Absolute alcohol 30.0
   Distilled water 100.0
   Concentrated ammonia 0.3
   } Two minutes.
3. Follow with 1 per cent. solution of paraphenylenediamin two minutes.
4. Counter stain with aq. pyronin (1 per cent.) thirty seconds.
5. Blot and examine with oil immersion lens.

Graham's Method.—Graham's alpha-pyronin method corresponded to the results obtained with the Pappenheim oxidase method. Beautiful pictures are

21. Schmorl, G.: Untersuchungenmethoden, Leipzig, 1914, p. 161.
22. Ikeda, Y.: Verhandl. der Japan path. Gessellsch., 1913, p. 86.
23. Klopfer, A.: Ztschr. f. exper. Path. u. Therap., 1912, **11**, 467.

obtained when the steps are carefully carried out as described by Graham, and the slides resemble blood films stained with Jenner's methylene blue eosin. The staining is done as follows:

1. Fix with alcohol-formaldehyd (9-1) two minutes.
2. Flood slide with
   Alpha naphthol 1.0
   Alcohol, 40 per cent.....100.0 } Five minutes.
   Hydrogen dioxid 0.2
3. Wash in running water fifteen minutes.
4. Stain with pyronin..... 0.5
   Anilin oil ..... 4.0 } Two minutes.
   Alcohol, 40 per cent.....96.0
5. Wash in water.
6. Stain with methylene blue BX 0.5 per cent. thirty seconds.

I have found that Loeffler's alkaline methylene blue may be substituted for the methylene blue BX, if the latter cannot be obtained.

7. Wash in water; blot.

The appearance of the oxidase granules in the various cells of normal blood are shown in Table 1:

TABLE 1.—NORMAL BLOOD

Series	Type of Cell	Pappenheim's Oxydase Stain; Counter-Stained with Pyronin	Graham's Stain
Myeloid.....	Poly. neutrophil	Numerous blue to violet granules; varying in size	Numerous red granules
	Poly. eosinophil	Large blue granules....	Numerous red granules (circles)
	Poly. basophil	Blue granules present; irregular in shape.	Granules unstained by pyronin and methylene blue
	Blood platelets; erythrocytes	No granules	No granules
Lymphoid.....	Lymphocytes	No granules; very rarely small black granules	No granules
	Plasma cells (irritation forms)	No granules	No granules
Monocytic.....	Transitionals	Few scattered black or violet granules (never blue) or no granules	No granules or few red granules varying in size
	Large mononuclears	No granules or few black; ocasionally few blue granules (myeloblasts?)	No granules, or a few red granules

THE OXIDASE GRANULES OF NORMAL BLOOD CELLS

The oxidase reaction in normal cells has been studied by a large number of investigators, who agree fairly well in regard to the marked reaction of the polymorphonuclear neutrophils, eosinophils and basopils. Pappenheim failed to obtain an oxidase reaction in the tissue basophilic cells. The eosinophils show the most marked reaction, but the neutrophils also show fairly large granules. Dunn[17] was unable to demonstrate oxidase granules in lymphocytes, even after long contact with the staining mixture. Sapegno[24] found oxidase granules in lym-

24. Sapegno, M.: Pathologica, 1908, **1**, 722; 1910, **2**, 131; Folia haemat., 1910, **9** (Zentral-Organ), 389.

phocytes and Fiessinger and Rudowska[16] noticed a slight indophenol reaction in the lymphocytes and monocytic cells after prolonged staining of blood films with thin dilute solutions. Dunn[17] attributes a marked reaction to the hyaline cells (corresponding to the monocytes), but his microphotograph of an oxidase hyaline cell is not convincing. Evans[25] says that the transitionals are the only mononuclear cells that contain oxidase granules, which he[26] claims are in as great abundance as in the neutrophils. Naegeli[27] believes that the large mononuclears and transitionals give a marked reaction to the oxidase solutions. Kiyono[28] found a few blue oxidase granules in histiocytes, but these were inconstant and most of the histiocytes did not contain any granules. Panton and Tidy[29] found that only some of the hyaline cells showed oxidase granules; the proportion of the oxidase hyaline cells corresponded to the number of hyalines which showed granules according to Leishman's stain. Pappenheim[30] states that the monocytes do not show oxidase granules. Sapegno found oxidase granules in blood platelets, reticulated erythrocytes and megakaryocytes, but his work is still unconfirmed. I have not been able to find any oxidase granules in such cells in blood and bone marrow smears. To determine the cause of this difference of opinion, careful counts were made on normal blood by various methods. The results of these counts only partially substantiate the evidence that the transitionals and large mononuclears (monocytes) show oxidase granules. Some of these cells do show a few blue granules with the various staining methods. Instead of the numerous distinct blue or violaceous granules, characteristic for the neutrophils, a few scattered dark bluish or black granules were found (Pappenheim's and von Gierke's methods). The large mononuclears occasionally show a few blue granules; such mononuclears may possibly be myeloblasts. The oxidase granules of the transitionals and large mononuclears are not lipoid particles. Prolonged treatment with alcohol or chloroform, however, fails to dissolve them. Rarely, fine black particles were observed in small round cells (lymphoid) as previously reported by Fiessinger and Rudowska. Graham, using his alphanaphthol pyronin method, found only a few red granules in endothelial leukocytes (transitionals and large mononuclears). These granules he believes are phagocytosed neutrophilic granules or the remains of phagocytosed leukocytes. That such cells are markedly phagocytic in character is well known. Winkler found that ptyalin, pepsin and

25. Evans, F. A.: The Archives Int. Med., 1916, **18,** 696.
26. Evans, F. A.: The Archives Int. Med., 1916, **17,** 1.
27. Naegeli, O.: Blutkrankheiten u. Blutdiagnostic, Leipzig, 1913.
28. Kiyono, K.: Die vitale Karminspeicherung, Jena, 1914, p. 53.
29. Panton, P. N., and Tidy, H. A.: Quart. Jour. Med., 1914, **7,** 340.
30. Pappenheim, A.: Ergebn. der inn. Med. u. Kinderh., 1912, **8,** 183.

typsin are unable to digest the granules of the leukocytes. Our results with the alphanaphthol-pyronin method (Graham) correspond with Graham's findings. Some of the large mononuclear and transitionals, however, did not show the red granules characteristic of this reaction. A few red oxidase granules, irregular in size, were found in some of the monocytes. Evans[26] says that the oxidase granules in the transitionals are just as numerous as in the polynuclear neutrophils. In my opinion, these cells were unquestionably metamyelocytes. The transitionals in his colored drawing resemble metamyelocytes. The myelocytes and metamyelocytes of chronic myeloid leukemias show an oxidase reaction as intensive as in the polymorphonuclear cells. Evans was dealing with premature myeloid cells.

The accompanying two blood counts (Tables 2 and 3) show the distribution of the oxidase granules in apparently normal blood.

TABLE 2.—OXIDASE GRANULES IN APPARENTLY NORMAL BLOOD

	Jenner-Giemsa* Per Cent.	Oxidase Stain			
		Graham Per Cent.		Pappenheim Per Cent.	
Polynuclear neutrophils.	54.2				
Poiynuclear eosinophils..	12.8	68.7	Many granules	66.7	Many granules
Polynuclear basophils ..	0.5				
Lymphocytes	23.8	24.3	No granules	27.0	No granules
Large mononuclears	3.5	1.0	Few granules	1.3	Few granules
		1.0	No granules	0.3	No granules
Transitionals	5.2	4.0	Few granules	4.0	Few granules
		1.0	No granules	0.7	No granules

TABLE 3.—OXIDASE GRANULES IN APPARENTLY NORMAL BLOOD

	Jenner-Giemsa* Per Cent.	Oxidase Stain			
		Graham Per Cent.		Pappenheim Per Cent.	
Polynuclear neutrophils..	68.0				
Polynuclear eosinophils..	6.7	72.0	Many granules	72.8	Many blue granules
Polynuclear basophils....				3.0	Few blue granules
Lymphocytes.....	20.3	23.0	No granules	18.4	No blue granules
				0.4	Few black granules
Large mononuclears.....	1.7	1.7	Few granules	0.4	Few blue granules
		0.7	No granules		
				0.4	Few black granules
				0.6	No granules
Transitionals.....	3.3	2.3	Few granules	2.2	Few black granules
		0.3	No granules		
				1.8	No granules

* For differential blood counts I have had splendid results with Pappenheim's panoptic stain for blood smears. The method is employed as follows: (1) Jenner, three minutes; (2) dilute with distilled water 1 minute; (3) wash slide quickly and stain fifteen minutes with diluted Giemsa (20 drops to 10 c.c. of ordinary tap water); (4) wash with tap water and blot.

OXIDASE GRANULES OF PREMATURE CELLS OCCURRING IN LEUKEMIAS

The following classification of cells in the leukemias is based on the study of a large number of leukemias at the Mount Sinai Hospital (to be reported elsewhere). As the data concerning the occurrence of oxidase granules in the premature cells are very few, the oxidase reaction was carefully studied in the cells found in the various

leukemias. Schultze,[9, 13] Marchand[31] and Peters[32] were able to identify acute myeloid leukemias by the presence of oxidase granules in ungranulated mononucleated cells, which up to that time had been considered lymphoid in character. They consider the reaction an important criterion for the differentiation of the lymphoid and myeloid leukemias. The cells which exhibit the oxidase granules were considered myeloblasts. Von Jagic,[33] Jochman and Blühdorn,[34] and Dunn[17] found that some of the myeloblastic and promyeloblastic cells in certain myeloid leukemias failed to show oxidase granules. The presence of oxidase granules in numerous mononucleated cells is evidence of a myeloid leukemia; its absence does not indicate a lymphoid leukemia, as we shall see later.

TABLE 4.—Oxidase Reaction in Premature Cells. Myeloid Series

Type of Cell	Granules with Jenner-Giemsa	Pappenheim Oxidase	Graham
Myelocytes	Neutrophils Eosinophils Basophils	Same as polys. Same as polys. Same as polys.	Same as polys. Same as polys. Same as polys.
Myeloblasts	"Azure" or a few neutrophilic; no granules	Most of the cells show a few or more blue granules; occasionally a cell contains no granules	Few or more red granules
Myelogones.....	No granules; Auer bodies or few azure granules	No granules unless Auer bodies or azure granules are present, when these cells show the oxidase reaction limited to the granules	No granules or few red granules in cytoplasm or red Auer body
Megakaryocytes	Nuclear particles	No granules	No granules
Erythroblasts	None	No granules	No granules

We have already noted (see Table 1 of normal blood cells) the division of the white blood cells into three series; (1) myeloid; (2) lymphoid, and (3) monocytic, and the various types of cells occurring in each series. The premature and mature cells, in the various leukemias, show an absolute increase in one series, so that three main types of leukemias exist (myeloid, lymphoid and monocytic). With proper staining methods (Pappenheim's panoptic stain is especially recommended) the various types of cells are well shown and can be recognized by their staining reactions, size and granules. Premature cells also contain granules which often form the basis of the oxidase granules. The oxidase reaction of the Auer[35] bodies (present in myelogones) is strongly positive and appears as a distinct blue rod. A small area of neutrophilic granules at one pole of a myeloblast will manifest

31. Marchand: München. med. Wchnschr., 1911, **58,** 924 and 1215.
32. Peters, J.: München. med. Wchnschr., 1909, **56,** 1478.
33. Von Jagic, N.: Berl. klin. Wchnschr., 1910, **47,** 874.
34. Jochmann and Blühdorn: Folia haemat., 1911, **12,** 181.
35. Auer: Am. Jour. Med. Sc., 1906, **131,** 1002. Ottenberg, R.: Proc. New York Path. Soc., 1909, **9,** 1.

itself by a few blue granules at that pole. The azure granules of the myeloblasts also show a marked oxidase reaction. The reactions of the rest of the cells are shown in Tables 4 and 5:

TABLE 5.—OXIDASE REACTION IN PREMATURE BLOOD CELLS

Series	Type of Cells	Granules	Graham	Pappenheim
Lymphoid	Lymphoblasts (small and large)	Few azure	None	None
Monocytic ...	Large mononuclears and transitionals	Nuclear particles	None	None

THE OXIDASE REACTIONS IN THE LEUKEMIAS

In view of these facts, can the oxidase reaction be considered a criterion for the differentiation between myeloid, lymphoid and monocytic leukemia? The reaction is not infallible, as the following blood count in a case of *acute myelogonic leukemia* shows.

Leukocytes, 35.800.
Differential (500 cells counted):

Myeloid Series:	Per Cent.	Absolute
Polynuclear neutrophils	5.8	2,076.4
Polynuclear eosinophils	0.2	71.6
Myelocytic neutrophils.....	3.6	1,288.8
Myeloblasts	4.8	1,718.4
Myelogones (no granules).....	73.7	26,384.6
Normoblasts	3.2	1,145.6
Lymphoid large and small lymphocytes...	8.4	3,007.2
Monocytic transitionals	0.3	107.4

It will be noticed that the myelogones (round or oval cells with reticulated, violaceous nucleus, well stained nucleolus or nucleoli and deep blue rim of cytoplasm, stained with Jenner and Giemsa stains) are the predominant cells, which can easily be confused with lymphocytes in poorly stained blood smears. The oxidase reaction (Graham's) of the same case (500 cells counted) was as follows:

	Positive, Per Cent.	Negative Per Cent.
Polynuclear neutrophils and eosinophils } Myelocytes }	15.2	
Myeloblasts	1.4	
Lymphocytes	....	6.8
Myelogones	....	76.6
Cells showing oxidase granules.....	16.6	
Cells showing no oxidase granules.....		83.4

At the first glance, or even count, of the oxidase stain, the large number of nonoxidase cells would lead one to believe that we are dealing with a lymphatic leukemia, but the absolute increase of myelocytes, the normal number of lymphocytes, the presence of myeloblasts and the great increase of the myelogones, which is a characteristic cell of the myeloid leukemias, make the diagnosis of acute myeloid leukemia certain. A similar leukemia showing the presence of Auer bodies in the myelogones, showed a positive oxidase reaction which was confined

to the Auer granules. The absence of a positive oxidase reaction is therefore no criterion of the differentiation of the various types of leukemia. The absolute increase of a certain series of cells, ascertained from well stained blood films, is of greater importance.

The following case of *acute myeloblastic leukemia* (myeloblasts predominant) illustrates the distribution of the oxidase granules in such a leukemia.

Hemoglobin, 48 per cent.; erythrocytes, 2,336,000; leukocytes, 65,600.

Differential (500 cells counted):	Per Cent.	Absolute No.
Polynuclear neutrophils	7.0	459.2
Myelocytic neutrophils	9.0	590.4
Myeloblasts	55.2	36,211.2
Myelogones	20.0	13,120.0
Lymphocytes	7.2	4,723.2
Transitionals	0.4	262.4
Normoblasts	1.0	656.0
Megaloblasts	0.2	131.2

Some of the myeloblasts contain either a few premature neutrophilic granules at one pole or show scattered azure granules. A large number of the myelogones show Auer bodies and occasionally small granules.

The results with the oxidase reaction were as shown in Table 6.

TABLE 6.—Results of Oxidase Reaction in a Case of Acute Myeloblastic Leukemia

Pappenheim's oxidase method:	Per Cent.	
Polynuclears	6	Many blue granules
Myelocytes	5	Many blue granules
Lymphocytes	10.5	No granules
Myeloblasts and myelogones	78.0	Few blue granules
	0.5	No granules
Graham alphanaphthol-pyronin method:		
	Per Cent.	
Polynuclears	6.0	Many red granules
	0.5	Few red granules
Myelocytes	12.5	Many red granules
Lymphocytes	6.5	No granules
Myeloblasts and myelogones	72.5	Few red granules
	2.0	No red granules

In this case the myeloblasts showed a few blue granules at one pole.

The following illustrates the blood count and the oxidase reaction (Table 7) in a case with a picture of a severe anemia, leukopenia, and the presence of premature myeloid cells in the blood, especially myelogones, containing Auer bodies in a great percentage:

Hemoglobin, 35 per cent. (Kuttner); erythrocytes, 1,720,000; leukocytes, 5,800.

Differential (300 cells counted):	Per Cent.
Polynuclear neutrophils	17.0
Polynuclear basophils	0.3
Lymphocytes	28.7
Neutrophilic myelocytes	6.3
Myeloblasts	20.7
Myelogones	26.0
Transitionals	1.0

TABLE 7.—Oxidase Reaction in Severe Anemia

	Per Cent.	Graham	Per Cent.	Pappenheim
Polynuclears and myelocytes	30	Many granules	24	Many granules
	4	Few granules		
Myeloblasts	23	Few granules	22	Few granules
Myelogones	10	Few granules (Auer bodies)	11	Few granules (Auer bodies)
	3	No granules	6	No granules
Lymphocytes	30	No granules	31	No granules
			2	Small black granules
Transitionals			0.5	Few dull black granules
			0.5	No granules

In a *monocytic leukemia,* in which the predominant cells resembled certain large mononuclears and the transitionals of normal blood, the oxidase reaction (Table 8) was negative in all the cells except the polynuclears and myelocytes. This leukemia was similar to one described incorrectly by Klein[36] as a myelogonic leukemia (Case 4 of his series). The so-called myelogones of Klein were large mononuclears or degenerated forms. Some of the nuclei of the large mononuclears and transitionals were pale, and a certain amount of the nuclear substance was diffused out into the cytoplasm where it appeared as fine granules. The degenerated monocytes of this leukemia never attained the larger size of megakarycytes, which are present in chronic myeloid leukemias. The nuclear granules did not show any oxidase reaction with a large number of methods and in spite of prolonged staining.

Monocytic Leukemia.—Hemoglobin, 68 per cent.; erythrocytes, 4,030,000; leukocytes, 245,000.

Differential (1,000 cells counted):	Per Cent.	Absolute No.
Myeloid:		
Polynuclear neutrophils	2.9	7,105
Polynuclear eosinophils	0.2	490
Polynuclear basophils	0.1	245
Myelocytes, neutrophilic	0.3	735
Myeloblasts	0.1	245
Myelogones	0.1	245
Lymphoid:		
Small lymphocytes	7.4	18,130
Large lymphocytes	0.7	1,715
Monocytes:		
Large mononuclears	67.0	164,150
Transitionals	20.4	49,980
Normoblasts	0.6	1,470
Megaloblast (one mitotic)	0.2	490

Note: Megakaryocytoid cells (degenerating large mononuclears) are not included in this count.

TABLE 8.—Pappenheim Oxidase Reaction (500 Cells Counted)

	Positive, Per Cent.	Negative, Per Cent.
Polynuclears, myelocytes and myeloblasts	4	..
Lymphocytes	..	17
Large mononuclears and transitionals	..	79

36. Klein, Stanislaus: Die Myelogonie, Berlin, 1914, p. 25.

The lymphoid cells in the lymphatic leukemias do not contain oxidizing substances.

Table 9 is a summary of the oxidase reaction in the various leukemias.

TABLE 9.—THE OXIDASE REACTION IN THE LEUKEMIAS.

Class	Predominating Cells	Oxidase Reaction
Myeloid	Myelogonic	Usually negative. Positive in a large number of cells if Auer bodies or fine granules are present
	Myeloblastic	Positive
	Myelocytic	Positive
Lymphatic	Lymphoblastic	Negative (a few myelocytes may be present)
	Lymphocytic (Large)	Negative
	(Small)	Negative
Monocytic	Transitionals and large mononuclears	Negative

THE RELATION OF THE GRANULES OF THE CELL TO THE OXIDASE REACTION

Winkler and Schultze consider the oxidase reaction to be due to the granules of the cell. In bone marrow smears one finds numerous scattered neutrophilic and eosinophilic granules, which react very distinctly with the alphanaphthol and dimethylparaphenylenediamin reagents. Panton and Tidy[23] found that only the transitionals and large mononuclears, which show granules with the Leishman stain, give the oxidase reaction. The granulated cells of the parotid and lachrymal glands show a marked oxidase reaction. Sapegno attributes the reaction to the ferments, which may have no relation to granules. Certain ungranulated cells, however, such as the endothelial (Ikeda[22]), reticulated red cells, lymphocytes and blood platelets (Sapegno[24]) are said to show an oxidase reaction. MacCallum[37] says that premature, ungranulated myeloid cells show an oxidase reaction, but this does not seem to be in conformity with the results of some of the investigators (Dunn[17] and Jochmann[34]). It is a mooted point whether one should consider the oxidation of the alphanaphthol-dimethylparaphenylenediamin to a dull black or even violaceous tinge an oxidase reaction, limited only to the myeloid cells. I have observed a distinct reaction in the reticulo-endothelial cells, and the periphery of the fat cells, in a section of a lymph node of the greater curvature of the stomach. The cytoplasm of the reticular and endothelial cells, with Pappenheim's oxidase stain, showed a dull black, diffuse coloration or fine granules; a few of these cells and most of the fat cells showed a diffuse violaceous stain. The reaction resembled that of the large mononuclears and transitionals of normal blood. The distinct blue reaction is present in myeloid cells which show neutrophilic or eosinophilic granules (mature or premature). In smears of myeloid leukemias I have found

37. MacCallum, W. G.: A Text Book of Pathology, Phila., 1916, p. 739.

that the oxidase cells correspond to the granule-bearing cells. The myelogone, the forerunner of all the myeloid cells, does not show any oxidase reaction unless Auer bodies or fine granules are present.

As a result of my investigations it may be stated that the oxidase reaction itself is not constant. Variations in results are frequently obtained in spite of careful technic, and this may account for the difference of opinion in regard to the reaction. Furthermore, the indophenol reaction is present in cells outside of the bone marrow, and large mononucleated cells which do not show the oxidase reaction are present in the bone marrow. One should therefore hesitate to attribute a myeloid origin to cells which show such a wide variation in their reaction to the oxidase stain, such as the transitionals and large mononuclears, for the origin of these cells from lymph nodes has been described by several investigators, notably by Weidenreich and Downey.[38] Furthermore, the value of the oxidase reaction is still further lessened by the fact that certain cells of definite myeloid origin, such as the myelogones and certain myeloblasts, do not show the oxidase reaction.

CONCLUSIONS

1. The oxidase reaction is not conclusive evidence of the myeloid origin of blood cells.

2. The reaction is not present in ungranulated premature bone marrow cells.

3. The reaction in premature bone marrow cells depends on the presence of granules (neutrophilic and so-called azure granules and Auer bodies).

4. The reaction in transitionals and large mononuclears is never as intense as in myeloblasts or neutrophilic myelocytes and often of a somewhat different character. The reaction may be absent in transitionals and large mononuclears, but some large mononuclears of normal blood show a reaction similar to myeloblasts.

5. The reaction is not present in lymphocytes, red blood cells, blood platelets, megakaryocytes and plasma cells (Türk's irritation form) of normal and leukemic blood.

6. Morphology, with good polychromatic staining of the blood cells, is of greater importance in the identification of the leukemias than the oxidase reaction.

1 East One Hundredth Street.

38. Weidenreich and Downey: Arch. f. mikr. Anat., 1912, **80**, 306.

RELATION OF PELLAGRA TO LOCATION OF DOMICILE IN SPARTAN MILLS, S. C., AND THE ADJACENT DISTRICT *

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INTRODUCTION

The geographic distribution of pellagra has always been a remarkable feature of this disease and has frequently been discussed by various investigators since the earliest recognition of pellagra. Special significance has usually been ascribed to this peculiar geographic distribution. Thus, for example, it has been argued that people who live in the same region consume the same diet and so are subject to the same dietary deficiencies, or again, that people living in certain regions are exposed to the attacks of certain insects, which live there, and thus acquire a disease transmitted by these insects. The possibility of such discordant interpretations indicates that a mere superficial examination of the geographic distribution of pellagra will not suffice to solve its etiology. An examination of this striking feature of the disease is nevertheless of obvious importance and the possibility still remains that a more intimate and exact study of geographic distribution may contribute much to our knowledge of pellagra. Such a study we hope to present in a series of papers on this general subject, beginning with a consideration of small geographic units and subsequently proceeding to a discussion of larger areas.

A first attempt at an intimate and exact study of geographic distribution of pellagra in small unit areas was made in our paper on the

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* From the Robert M. Thompson Pellagra Commission of the New York Post-Graduate Medical School and Hospital.

* This is the tenth paper in the series now appearing in THE ARCHIVES, constituting the third report of the Robert M. Thompson Pellagra Commission. The epidemiologic surveys in 1915 and 1916, utilized in this paper, have been made and the final copy of the paper itself has been written since Dr. Garrison and Dr. Siler were recalled to active service in the Medical Corps, U. S. Navy, and the Medical Corps, U. S. Army, respectively. They are, therefore, not personally responsible for the observations of the last two years, for the compilation of the data, or for the deductions drawn from them.

relation of pellagra to domicile, presented before Section K of the American Association for the Advancement of Science at the Atlanta Meeting, January 2, 1914, published in our second progress report.[1]

A further paper dealing in part with the same topic was presented at the Third Triennial Pellagra Conference at Columbia, S. C., in October, 1915, and an extended abstract of it is to appear in the proceedings of that conference when published. As a result of these studies we concluded that pellagra spread from preëxisting cases and was transmitted through only relatively short distances in the communities studied. The data upon which the discussion and conclusions were based were presented only in summarized form and probably, in part at least, because of this fact, the evidence seems not to have been fully and clearly appreciated.

On this account, we have decided to present in some detail our material relating to geographic distribution of pellagra, so that those who care to examine the material may be able to decide for themselves whether our analysis of the data is or is not fallacious.

In the present paper the community of Spartan Mills, Spartanburg, S. C., and the immediately adjacent district will be considered, with particular attention to the exact residence of each pellagrin in this community and the possible relation between location of domicile and the origin of new cases of pellagra.

GENERAL DESCRIPTION OF THE COMMUNITY *

The community of Spartan Mills is situated in the fifth and sixth wards in the northwestern part of the city of Spartanburg. When the first mill was erected its capacity was 30,000 spindles. Several years later a second mill was constructed and in 1914 the capacity of the two mills was 85,000 spindles. The motive power is steam and the manufactured products are sheetings, shirtings and narrow print cloth. Most of the village is situated on high ground with excellent drainage. Water for the mills is impounded in an open reservoir just north of the mills. The village is laid out in streets and in addition to the tenement houses, has several stores, a social settlement house (the Wesley Home at 339 Brawley Street), two churches and a hospital, located at 328 Forest Street. This building was used as a general hospital until

1. Siler, J. F., Garrison, P. E., and MacNeal, W. J.: A Statistical Study of the Relation of Pellagra to Use of Certain Foods and to Location of Domicile in Six Selected Industrial Communities. THE ARCHIVES INT. MED., 1914, **14**, 292; Second Progress Report of the Thompson-McFadden Pellagra Commission of the New York Post-Graduate Medical School and Hospital, New York, 1915, p. 15.

* We are indebted to Mr. W. S. Montgomery, President of Spartan Mills, and to Mr. W. J. Britton, Superintendent of Spartan Mills, for important information used in this section of the paper.

1913, in which year it was converted into a charity pellagra hospital under our supervision. In 1914 the building was placed in charge of the U. S. Public Health Service and after extensive changes it was reopened as a pellagra hospital in the fall of that year. Each tenement is allotted a plot of ground for garden and the tenants are permitted to keep cows on their premises. Nearly all the children under 12 years attend the public schools of the city, although this was not the case several years ago.

The expansion of the city of Spartanburg during the past twenty years has occurred in part in this district, so that new streets lined with private dwellings have appeared in the district about the mill

Fig. 1.—Spartan Mills, looking northeast from the corner of Forest and College Streets. The houses are examples of the larger dwellings constructed since 1907.

village proper in the last ten years and new houses have been erected here very recently.

When first constructed, the village contained 155 tenement houses located on Jennings, Burnett and Colton Streets and in the region east of the present Brawley Street. The original houses on Jennings, Burnett and Colton Streets are still used but the rest of the village was swept away by a great fire in 1907. This portion was rebuilt and the village was extended westward, so that at present there are 265 tenement houses, some of them accommodating two or more families. All the houses are of wood with open brick foundation. Most of them contain four, five or six rooms, but a few contain ten rooms. The old original houses, indicated by oblong rectangles on the map, are two-

storied, four-room structures, built at an average cost of $110 per room. The newer houses are of much better construction. Figure 1 shows a view of College Street, looking northeast from the corner of Forest and College Streets. Figure 2 was photographed from the second story of the hospital at 328 Forest Street, looking west. The bridge at the upper left corner of this picture is at the point where Farley Avenue crosses the railroad track.

The assignment of houses depends on the character and the reliability of the operatives and no family is permitted to occupy a house unless some of its members are employees of the company. The houses on Jennings and Burnett Streets are rent-free and those on Colton

Fig. 2.—Spartan Mills, looking west from the back of the second floor of the hospital building at 328 Forest Street. This picture shows the type of smaller houses constructed since 1907.

Street rent for 25 cents per room per month. For the remaining houses the rental varies from 40 cents to $1.00 per room per month, the average being about 60 cents. Until 1893 no rents were charged. The present rents suffice for repairs and maintenance.

The water supply for the community was obtained from open wells until 1910. Since then the supply has been furnished from pipes connected to the water mains of the city of Spartanburg, hydrants being located at convenient intervals along the streets. Late in 1913 these pipes were continued into each house, the installations being completed in May, 1914. The water used since 1910 has been, therefore, the same as for the city as a whole.

The method of disposal of human excreta until 1905 was by means of open surface privies, the excreta being deposited on the surface of the ground. In 1905 wooden boxes were installed underneath the seats. Ultimate disposal was by scavenger service, the annual cost being $400 for the entire village. The boxes were emptied once a week. No attempt was made to screen against flies; the doors of the outhouses were left open, seats uncovered and the catch-boxes were not water tight. In 1913 the installation of a water-carriage system of sewage disposal was begun and this was completed in May, 1914. The time when each group of houses was connected with the sewer is indicated on the maps for 1913 and 1914, Figures 9 and 10. The total water closets installed numbered 316. The total cost of the installation of piped water, kitchen sinks and water closets was approximately $39,000. The water is now purchased from the city at the flat rate of $2,460 per year and the estimated cost of inspection and maintenance is $600 per year. Each tenant is required to pay an extra rental of $1.00 per month for the sanitary improvements and the annual income on this account is approximately $3,500. With very rare exceptions, the householders are highly pleased with the improvement and gladly pay the extra charge.

During the period of our survey, 1912 to 1916, inclusive, there was observed a marked improvement in general sanitation in this community. Most notable, of course, was the sewer installation. Along with that there has been also improvement in general cleanliness, with diminished scattering of garbage and refuse. In 1913 and 1914 there was a very noticeable increase in the use of wire screens on windows and doors, but in 1915 and 1916 these had generally become dilapidated and had not been renewed, partly because flies were much less troublesome than in previous years.

INSECTS

The house fly (*Musca domestica*) is very abundant during the summer but considerably less numerous since the improvement in sanitation in 1914. The stable fly (*Stomoxys calcitrans*) is moderately abundant. The custom of keeping cows in the immediate vicinity of the dwellings has been continued in this community and this fly was apparently as abundant as ever in 1916. Mosquitos are not numerous although some are observed at times. The bedbug (*Cimex lectularius*) is present in nearly every house, but its numbers vary according to the housekeeper. The head louse (*Pediculus capitis*) is common, particularly on the children. The body louse (*Pediculus vestimenti*) has not been observed. The sand-fly (*Simulium*) has not been observed in this village, although potential breeding places exist there. In 1916 large numbers of small, black flies were observed. These appeared not

to be blood-sucking flies, but were seen especially on the margins of the eyelids of the children, many of whom had a mild conjunctivitis. During our survey in August, 1916, these flies were a frequent personal pest, always attacking the eyes. Apparently they are very common on cattle.

POPULATION

The population of this community has come, for the most part, from the mountainous section of western North Carolina, with a few

TABLE 1.—DISTRIBUTION OF THE WHITE POPULATION OF SPARTAN MILLS ACCORDING TO SEX AND AGE, IN EACH YEAR

Age	1913			1914			1915			1916		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
0- 4	83	98	181	95	102	197	101	88	189	103	109	212
5- 9	89	103	192	85	102	187	84	108	192	94	105	199
10-14	102	101	203	96	110	206	92	95	187	95	93	188
15-19	97	99	196	86	95	181	109	100	209	118	107	225
20-24	82	72	154	94	75	169	104	70	174	114	74	188
25-29	70	54	124	58	48	106	53	44	96	55	57	112
30-34	46	47	93	57	43	100	45	36	81	47	33	80
35-39	43	33	76	48	39	87	63	46	109	51	48	99
40-44	43	31	74	41	30	71	47	33	80	49	32	81
45-49	19	22	41	18	23	41	23	27	50	29	30	59
50-54	24	23	47	24	15	39	18	22	40	19	18	37
55-59	13	14	27	14	11	25	18	13	31	20	21	41
60-64	8	12	20	17	15	32	14	10	24	12	7	19
65-69	5	7	12	5	7	12	5	6	11	3	5	8
70-74	7	6	13	6	8	14	5	6	11	6	5	11
75-79	3	1	4	2	0	2	4	2	6	6	3	9
Over 80	0	1	1	0	1	1	1	2	3	1	1	2
Age unknown	8	9	22*	8	9	20†	2	3	5	0	0	0
Total	742	733	1,480*	754	733	1,490†	787	711	1,498	822	748	1,570

* Including five individuals whose sex and age were not recorded.
† Including three children whose sex and age were not recorded.

families from eastern Tennessee. The supply of labor from the immediate vicinity is irregular and depends very much on the condition of the farm crops. In a poor year many come from the farms into the cotton mill. Foreign labor was not employed. A census of the population taken by us in 1913, 1914, 1915 and 1916 yielded the statistics shown in Tables 1, 2 and 3. The average size of families was about four members. Up to 1914 approximately 25 per cent. of the

TABLE 2.—Distribution of the White Population of District Adjacent to Spartan Mills, According to Sex and Age, in Each Year

Age	1913			1914			1915			1916		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
0- 4	7	4	11	13	20	33	19	20	39	20	26	46
5- 9	6	7	13	20	15	35	22	13	35	19	13	32
10-14	8	11	19	11	15	26	12	16	28	16	12	28
15-19	3	4	7	11	7	18	15	4	19	14	12	26
20-24	5	2	7	14	7	21	15	8	23	16	9	25
25-29	6	6	12	13	16	29	15	15	30	16	13	29
30-34	4	2	6	10	7	17	9	10	19	9	14	23
35-39	3	6	9	6	6	12	10	10	20	15	8	23
40-44	1	0	1	3	5	8	5	4	9	5	4	9
45-49	2	2	4	5	2	7	5	3	8	7	6	13
50-54	1	3	4	3	4	7	4	3	7	7	5	12
55-59	0	0	0	2	3	5	2	3	5	3	4	7
60-64	2	0	2	5	2	7	6	3	9	2	2	4
65-69	1	1	2	3	2	5	3	2	5	7	2	9
70-74	0	0	0	0	0	0	0	1	1	0	1	1
75-79	1	0	1	1	0	1	0	0	0	0	0	0
Over 80	0	0	0	0	0	0	0	0	0	0	0	0
Age unknown	1	1	2	1	1	2	0	0	0	2	7	9
Total	51	49	100	121	112	233	142	115	257	158	138	296

TABLE 3.—Distribution of Negro Population in Spartan Mills and in Adjacent District, According to Sex and Age, in Each Year

Age	1913			1914			1915			1916		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
0- 4	3	0	3	5	0	5	5	1	6	3	0	3
5- 9	2	0	2	2	1	3	2	0	2	2	0	2
10-14	1	3	4	1	3	4	1	2	3	1	1	2
15-19	0	4	4	0	4	4	0	5	5	0	4	4
20-24	2	1	3	4	2	6	3	1	4	3	2	5
25-29	1	0	1	3	0	3	5	2	7	4	2	6
30-34	0	1	1	0	1	1	0	2	2	1	1	2
35-39	1	1	2	2	1	3	1	0	1	1	1	2
40-44	0	0	0	0	1	1	0	1	1	0	0	0
45-49	1	1	2	1	1	2	1	0	1	1	1	2
50-54	0	1	1	0	1	1	0	2	2	0	1	1
55-59	0	0	0	0	0	0	0	0	0	0	1	1
60-64	0	0	0	0	0	0	1	0	1	1	0	1
65-69	0	0	0	0	0	0	0	0	0	0	0	0
70-74	0	0	0	0	0	0	0	0	0	0	0	0
75-79	0	0	0	0	0	0	0	0	0	0	0	0
Over 80	0	0	0	0	0	0	0	0	0	0	0	0
Age unknown	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	23	18	15	33	19	16	35	17	14	31

population remained less than a year. Since 1914, however, there has been a greater tendency for the people to remain.

The negro residents, as shown in Table 3, formed a very small proportion of the population in this particular community. A few were employed in the mill, while some of the women were cooks or laundresses for the white residents. In the more well-to-do families in the adjacent district, negro women were commonly employed by the day as maids. These, however, have not been included in Table 3, as

TABLE 4.—DISTRIBUTION OF THE WHITE MILL OPERATIVES RESIDING IN SPARTAN MILLS PROPER, ACCORDING TO SEX AND AGE, IN EACH YEAR

Age	1913			1914			1915			1916		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Under 12	2	1	3	1	2	3	1	1	2	0	1	1
12-14	55	55	110	48	59	107	49	47	96	39	43	82
15-19	87	91	178	68	77	145	92	91	183	99	98	197
20-24	50	52	102	60	61	121	76	62	138	67	60	127
25-29	25	39	64	26	37	63	29	34	63	29	51	80
30-34	6	42	48	19	36	55	17	26	43	15	25	40
35-39	7	27	34	11	36	47	19	37	56	12	42	54
40-44	6	21	27	8	20	28	11	19	30	15	25	40
45-49	3	16	19	1	16	17	4	20	24	4	20	24
50-54	1	15	16	0	10	10	0	15	15	0	16	16
55-59	0	11	11	0	10	10	1	12	13	1	14	15
60-64	0	7	7	1	10	11	1	5	6	0	4	4
65-69	1	5	6	0	2	2	0	3	3	0	4	4
70-74	0	1	1	0	3	3	0	1	1	0	1	1
75-79	0	0	0	0	0	0	0	1	1	0	1	1
Over 80	0	0	0	0	0	0	0	0	0	0	0	0
Age unknown	5	9	14	1	4	5	0	1	1	0	0	0
Total	248	392	640	244	383	627	300	375	675	281	405	686

they returned at night to their homes which were in the negro quarter of the city of Spartanburg, beyond the limits of the mill village.

INDUSTRIAL AND ECONOMIC CONDITIONS

When families coming from the mountains, having only unskilled laborers, apply for work in the mill, the authorities require that they have at least three potential operatives in order to be assigned a house. In the case of skilled laborers this requirement is lowered, and some families are accepted with only one operative on the pay-roll. Families unable to meet these requirements have been compelled to obtain houses

beyond the confines of the mill village proper. On Aug. 14, 1914, there were 849 employees, 809 white and 40 colored. Of the white employees, 630 * lived in the mill village and 179 outside of it.

The distribution, according to sex and age, of the mill operatives residing in the mill village in each of the four years, 1913 to 1916, inclusive, is indicated in Table 4. Some residents of the adjacent district were also employed by the mill company, but in most instances these persons held positions of responsibility and of higher remuneration. These have not been tabulated.

In this mill we were able to obtain, through the kindness of Mr. W. J. Britton, Superintendent of the mill, explicit information in

TABLE 5.—Data in Regard to Labor in the Spinning Room of Spartan Mill No. 2

Group	March 22, 1904			Feb. 15, 1911		
	Spinners	Sides Attended	Total Sides for the Group	Spinners	Sides Attended	Total Sides for the Group
1	2	1	2	0	1	0
2	10	2	20	1	2	2
3	10	3	30	0	3	0
4	14	4	56	5	4	20
5	9	5	45	0	5	0
6	38	6	228	9	6	54
7	1	7	7	0	7	0
8	0	8	0	28	8	224
9	0	9	0	1	9	9
10	0	10	0	8	10	80
11	0	11	0	1	11	11
12	0	12	0	4	12	48
Total	84	4.62	388	57	7.86	448

regard to wages actually paid to a group of operatives in one of the spinning rooms in March, 1904, in February, 1911, and in September, 1914. This is the only instance in which we have been able to obtain accurate figures for periods of time widely separated. On March 22, 1904, the superintendent recorded the actual work performed and the wages in the spining-room of Mill No. 2 and again on Feb. 15, 1911, he made a similar record for the same room. The figures for work performed are shown in Table 5.

* Table 4 shows 627 white employees living in the village proper. This table presents the data obtained by our census in June and July, 1914. The figure 630 was obtained from the mill records for the day, Aug. 14, 1914.

In 1904 the rate of pay was 8 cents per side, so that the average daily wage of the eighty-four employees in this room was 37 cents. In 1911 the rate was 11 cents per side, so that the average wage of the fifty-seven employees was 86 cents per day. In September, 1914, the average number of sides per spinner in this room was found to be nine and the rate of pay was still 11 cents per side, with an increase to 11½ cents for those who worked full time. The average daily wage in 1914 was, therefore, 99 cents. This alteration in wages seems, according to available information, to be typical of the economic changes in the cotton-mill industry in the South during this time. There has been a considerable increase in wages in ratio to the amount of work performed, amounting to approximately 40 per cent. since 1904, but much more important than this has been the increase due to the improved efficiency of the individual worker, brought about through education and the installation of refined machinery. Thus, in 1911 only 57 spinners accomplished more work than the 84 employed in the same room in 1904. It may be mentioned, also, that the number of working hours per day was eleven in 1904 and ten in 1914. Many of the employees of the spinning room were children between 12 and 16 years of age.

In 1914 the adult mill workers were paid about $1.20 per day, the men receiving a little more than the women, on an average. The number of wage earners per family was variable, the average being about two and a half. The average monthly wage per family was between $65 and $75. From 1904 to 1914 it is estimated that the average cash wage of mill operatives had increased 50 per cent. About 10 per cent. of the operatives saved a part of their wages. Some owned property near the mill village and a few had money on deposit with the treasurer of the mill, on which interest was allowed at the rate of 6 per cent. In 1914 the number of employees with money on deposit was somewhat less than in previous years.

In 1915 economic conditions in the mill village were less favorable than in 1914. There was a considerable influx of workers from the surrounding district and the less skilled operatives were unable to work full time. The business depression, however, affected the mill people less than the farmers, because the mills continued to run and to pay the same scale of wages. In 1916 economic conditions improved considerably, the excess of hands found work elsewhere and there was a slight increase in the scale of wages paid.

GENERAL DIETARY

The general dietary of the people in the village was investigated by personal interview at the house of every family in it, by interviews with

the mill authorities and with the managers of the stores and meat markets located in and near the village. A comparative study of the relation of the use of particular foods to pellagra, published in our second report,[1] included data obtained in this village, there designated as Village Sp. Since the publication of that paper the interest in the relation of diet to pellagra seems to have shifted from the question of a single particular food to a consideration of general nutritional sufficiency of the diet or to the possible absence of some hypothetical essential element from the diet. In a later paper we hope to contribute something to the discussion of this somewhat intangible conception; in the present instance, only the recorded information in regard to general dietary will be stated.

As the village is located within the city of Spartanburg many purchases are made from stores and markets having no connection with the mill company. About half the families made the bulk of their purchases at the Company Store. There were two meat markets within the community, one on Green Street and one on Howard Street, and a third just at the edge of it on Wofford Street. The owner of the market on Green Street had conducted this shop since 1907. During the summer he sold one carcass of beef per week and in winter two beeves per week and considerable fresh pork. Fresh beef sold for 10 cents per pound in 1907 and for 20 cents per pound in 1914, and he thought that less of it was used in 1914 than in previous years. The butcher on Howard Street had kept a meat shop in or near the village for twenty years. He said that the mill people ate less fresh meat than the people of the surrounding neighborhood, both classes being among his patrons. Much less fresh meat was used during the summer. Fresh pork was used extensively during the winter, especially by the mill people. From April to October he handled two beeves per week, and from October to April between four and five beeves per week. He received 10 cents per pound for beef in 1904 and 20 cents in 1914.

About one quarter of the families in the mill village possessed one or more cows and many other families purchased milk daily. Hogs were not allowed within the city limits. Chickens were kept by many families and eggs were quite generally used, more especially, of course, in April, May and June.

Each householder had a garden plot and approximately 90 per cent. raised a garden every year, the common vegetables being corn, snap beans, peas, tomatoes, onions, okra, butter beans, cabbage and turnips. Fresh vegetables were also sold by peddlers and by the stores. The gardens in 1914 were the poorest in many years. They were somewhat better in 1915, but again rather poor in 1916.

The staple articles of diet used throughout the year were wheat flour, cornmeal, bacon, canned vegetables, butter-milk, butter and, to a less extent, eggs. During the summer the staple vegetables were green corn, snap beans, okra, onions, butter beans, cabbage, tomatoes and peas. During the winter the staple vegetables were white potatoes, sweet potatoes (yams), army beans, navy beans, field peas and canned vegetables. Fresh beef was quite generally used in winter, but much less in summer. Fresh pork was extensively used during the winter. In 1913 our house-to-house inquiry indicated that more fresh meat was eaten in this mill village than in any other in Spartanburg County. We could not discover any marked changes in dietary habits during the past ten years which would serve to explain the absence of pellagra from the village from 1900 to 1905 and its high rate of prevalence from 1911 to 1914. Furthermore a careful inquiry during our house-to-house canvass in 1915 and 1916 failed to reveal any general change in the dietary habits of this population from those of previous years.

PREVAILING DISEASES

The acute infectious diseases of childhood occasionally prevailed here in epidemic form. Diarrheas and dysenteries were very prevalent among both children and adults, especially during the summer months, up to 1914. Since then there has been a remarkable improvement in this respect. The typhoid rate was always disproportionately high in this part of the city until 1914, since which time only very few cases of this disease have occurred here. Pulmonary tuberculosis was always present, with one or two deaths from it each year. In 1916 there were two deaths from consumption. Indigenous malaria did not occur and hookworm disease was only occasionally observed.

PELLAGRA IN THE SPARTAN MILL DISTRICT PREVIOUS TO 1912

The earlier history of pellagra in this village is somewhat obscure. So far as we have been able to ascertain, pellagra was not present before 1905. In 1905 and 1906 Pellagrin 633 lived in a house located on Forest Street, where House 338 now stands. The old house was destroyed in the great fire of 1907. This man, Pellagrin 633, did not suffer recurrence of pellagra in 1905 or 1906.

In 1907 a woman, Pellagrin 361, moved into a house on Colton Street, probably 131 Colton Street, although it may have been 127 or 135. She is known to have had pellagra there in 1907, but whether she had previously suffered from it is uncertain. Another woman, Pellagrin 445, who was socially intimate with her, also had pellagra in 1907 at 254 College Street. The record in regard to her is not quite clear either. It is possible that her first attack occurred in 1906 at

Fig. 3.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present previous to 1909.

226 Green Street, but the weight of evidence indicates that the initial attack appeared at 254 College Street. At 175 Burnett Street Pellagrin 444, a girl aged 3, developed pellagra in 1907, shortly after moving there. At 117 Johnson Street, a house outside the mill property, Pellagrin 778 resided in 1907 and 1908. She appears to have suffered her initial attack in 1906. Whether she had a recurrence in 1907 is uncertain.

In 1908 Pellagrin 444 suffered a recurrence at 175 Burnett Street and Pellagrin 778 had a recurrent attack at 117 Johnson Street. Three possibly incident cases appeared. Pellagrin 1229, a married woman, had pellagra at 296 Brawley Street. There is no record of the length of her residence there, nor do we know whether or not she had pellagra before. At 158 Jennings Street Pellagrin 1441, a married woman, aged 37, developed an initial attack in 1908. She had lived in this house since 1905. In 1909 she suffered a recurrence in North Carolina and died there on May 17, 1909. The third incident case was that of Pellagrin 364, a girl aged 7, who suffered her initial attack at 137 Duncan Street and who died of pellagra in this same house in July, 1909. The family came from North Carolina, but the length of their residence in Spartan Mills or in the house at 137 Duncan Street is unknown. In 1908 there were two pellagrins without recurrence in the community. One of these, Pellagrin 633, lived at 189 Farley Avenue. This was the same man who had lived at 338 Forest Street in 1905 and 1906 without recurrence. The other patient, Pellagrin 70, lived at 113 Oliver Street from April in this year. She had been a pellagrin since 1905.

In 1909 Pellagrin 444 suffered a recurrence at 175 Burnett Street, the same house in which she had an initial attack the previous year. Pellagrin 364 had a recurrence and died at 137 Duncan Street. At 135 Milan Street Pellagrin 296, a woman who had suffered from the disease since about 1903, moved in about January 1, 1909, and died of pellagra in June, 1909. An unrelated woman, Pellagrin 115, lived in this same house, or in a house next door, from February to July, 1909, and she suffered a first attack of pellagra here in June, 1909. In July, 1909, she moved to 133 Farley Avenue, where her residence is indicated by a hollow circle. At 137 Johnson Street Pellagrin 116, a widow, had been living with her son since October 4, 1907. She suffered a first attack of pellagra in the spring of 1909. She associated with Pellagrin 296, who died at 135 Milan Street that year, but we have not been able to learn the details in regard to this association. At 177 Farley Avenue Pellagrin 372, a man who had resided there since 1907, suffered a definite attack of pellagra in 1909. There is some evidence that he had had pellagra the preceding year, but it is not very definite. At 150 Manning Street a married woman, Pellagrin 365, died of pel-

Fig. 4.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1909.

lagra on June 2, 1909, and her husband, Pellagrin 1275, had an attack of the disease at the same time. After her death he went to the mountains in North Carolina and is said to have recovered. Further information is lacking and we do not know whether one or both of these persons may have had pellagra in a previous year, nor do we know how long they had resided in this house. The sixth incident case placed in this community in 1909 was that of Pellagrin 237 at 131 Colton Street. The first erythema in this case occurred in the spring of that year. From 1902 to 1908 she had resided at 114 Wolfe Street, immediately in the rear of 131 Colton Street. A case possibly incident in Spartan Mills in 1909 was that of Pellagrin 94 at 272 Brawley Street. This patient was a woman who moved here in March, 1909,

TABLE 6.—Active Cases of Pellagra in Spartan Mills and Adjacent District in 1910, But Not Incident Here in 1910

House	Residence Period	Pellagrin	Sex	Age
117 Allen	February on	445*	F	25
175 Burnett	To June	444*	F	6
116 Colton	June on	444*	F	6
131 Colton	Entire year	237	F	56
182 Dickson	Summer on	515	M	53
133 Farley	Entire year	115	F	26
177 Farley	Entire year	372	M	40
137 Johnson	Entire year	116	F	50
5 Langford	To February	445*	F	25
138 Montgomery	To February	22	M	7

* This case appears twice in this table because of change of residence during the year. It should be mentioned, also, that Pellagrins 64 and 65, in whose cases the initial erythemata appeared at 160 Burnett Street in 1910, moved to 371 Arch Street in October, 1910, and are indicated there by hollow circles on the map for 1910, Figure 5.

and developed an initial erythema in April, 1909. Pellagrin 64 was a second patient in whose case the disease was possibly incident in 1909 at 160 Burnett Street. His erythema appeared in February, 1910, in the same house where he had lived since 1907. In the apartment house at 138 Montgomery Street Pellagrin 22, a boy aged 6, resided from February, 1909, until February, 1910. He had his first attack in 1908, before moving here, but whether the disease recurred in 1909 is uncertain. It did recur in 1910, however. At 5 Langford Street Pellagrin 445 lived during 1909 and she suffered a recurrence there. One old pellagrin, without recurrence, resided in the village in 1909, namely, Pellagrin 70, who lived at 113 Oliver Street until September and thereafter at 343 Forest Street. This patient is indicated by hollow circles

on the map (Figure 4) at both of these residences. The record of Pellagrin 1229 at 296 Brawley was indefinite in 1909.

In 1910 there was only one pellagrin without recurrence living in this community, namely, Pellagrin 200 at 288 Brawley Street from January to July, 1910. There were two for whom the record of recurrence is indefinite: Pellagrin 1229 at 296 Brawley Street and Pellagrin 70 who lived at 343 Forest Street until March and at 334 Forest Street for the rest of the year. There were eight pellagrins in whom the disease was active in 1910, whose initial attack occurred previous to 1910 or at some other place in 1910. These cases are shown in Table 6. Two of these, Pellagrins 444 and 445, changed their residences in 1910 from 175 Burnett Street and 5 Langford Street to 116 Colton Street and 117 Allen Street, respectively. They are indicated at each of their residences by hollow circles on the map for 1910, Figure 5.

There were six cases of pellagra in which the initial attack in 1910 possibly, but not definitely, occurred in this district in 1910. At 397 Arch Street Pellagrin 198 resided from December, 1910, to January, 1911. In this case the initial erythema appeared in March, 1911, after he had removed to 343 College Street. Previous to December, 1910, he had lived at 3 F Street, Inman Mills, next door to Pellagrin 37. He has been considered as possibly incident at each of these three domiciles. As he was a man 40 years of age, the probable origin would appear to be at Inman, with an incubation period of at least five months. At 160 Burnett Street Pellagrin 64, a man aged 54, resided from 1907 to October, 1910, and in this case the initial erythema appeared in February, 1910. He is considered to have contracted the disease at this house, but probably incident in 1909 rather than in 1910. At 142 Colton Street Pellagrin 374, a boy aged 8, resided from March to the end of 1910 and developed an initial erythema in April. Previously he had lived at Saxon Mills. At 137 Johnson Street Pellagrin 53, a woman aged 42, lived with and nursed her mother, Pellagrin 116, during attacks of pellagra in the spring of 1909 and the spring of 1910. In the summer of 1910 she, herself, developed an initial erythema at her home at Pacolet Mills. At 113 Oliver Street Pellagrin 834, a woman aged 46, visited in 1910. She suffered an attack of pellagra some time after her arrival in March and she died of pellagra on September 9, 1910, in the Good Samaritan Hospital at 328 Forest Street. It is not improbable that she had pellagra before coming to this community, but her case is considered as possibly incident here. At 120 Wolfe Street Pellagrin 91 was living from November, 1909 to August, 1910. She was ill at this house with sore mouth, diarrhea and loss of weight. Erythema was not observed in this year, but did appear in 1911. She may have had pellagra in 1910.

Fig. 5.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1910.

Of these six rather problematical cases, three probably contracted pellagra elsewhere, or in a preceding year, namely, Pellagrins 198, 374 and 834; while three, namely, Pellagrins 64, 53 and 91, in all probability contracted the disease in this community.

The eleven cases of pellagra which have been designated as incident in this community in 1910 are shown in Table 7 and the house in which each case had its origin is indicated by a red circle on the map, Figure 5. Of the eleven cases, seven originated in houses in which antecedent pellagrins were living. Two cases arose in houses situated next door to active cases of pellagra, namely, those of Pellagrin 362 at 360 Brawley Street, in next-door relationship to 177 Farley Avenue and Pellagrin 69, who had her initial erythema some months later at 363 Forest Street, in next-door relationship to 360 Brawley Street.

TABLE 7.—Cases of Pellagra Incident in Spartan Mills and Adjacent District in 1910

House	Residence Period	Pellagrin	Sex	Age
288 Brawley	To July	201	F	22
360 Brawley	To May—death	362	F	33
109 Burnett	To October	65	F	51
175 Burnett	To June—death	349	M	50
303 College	Entire year	348	F	40
153 Duncan	Entire year	750	F	18
177 Farley	To Dec.—death	371	F	16
334 Forest	Entire year	194	F	26
363 Forest	Entire year	69	F	17
134 Montgomery	To spring	654	F	7
112 Oliver	February on	749	F	17

The other two new cases arose in houses apparently one removed from next-door relationship to a case of pellagra, namely, those of Pellagrin 750 at 153 Duncan Street and Pellagrin 348 at 303 College Street.

In 1911 many more known cases of pellagra resided in Spartan Mills. This is at once evident from the map for 1911, Figure 6. There were two old pellagrins who escaped recurrence in 1911, Pellagrin 444 at 116 Colton Street, and Pellagrin 654 at 147 Milan Street. There were three old pellagrins with indefinite record in 1911, Pellagrin 237 at 131 Colton Street, Pellagrin 750 at 153 Duncan Street, and Pellagrin 70 at 334 Forest Street. There were seventeen pellagrins with active symptoms in 1911, who had contracted the disease previous to 1911 or elsewhere in 1911. These are shown by open circles on the map and are enumerated in Table 8. There were three additional cases,

Fig. 6.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1911.

those of Pellagrins 238, 203 and 204, who had initial attacks in this community in 1911 and subsequently moved into other houses here. They are indicated at these later residences by open circles on the map, Figure 6, at 119 Manning Street and 127 Manning Street, to which houses the patients moved in December, 1911.

TABLE 8.—Active Cases of Pellagra in Spartan Mills and Adjacent District in 1911, But Not Incident Here in 1911

House	Residence Period	Pellagrin	Sex	Age
117 Allen	To February	445	F	26
118 Allen	February on	445	F	26
371 Arch	Entire 1911	64	M	55
371 Arch	Entire 1911	65	F	52
145 Burnett	Feb. to Aug.	99	F	7
203 College	To Jan. 20—death	348	F	41
142 Colton	To Dec.—death	374	M	7
132 Dickson	Entire year	515	M	54
133 Farley	Entire year	115	F	27
177 Farley	To spring—death	372	M	50
334 Forest	Entire year	194	F	27
363 Forest	Entire year	60	F	18
111 Jennings	April on	207	F	28
116 Johnson	Entire year	11	F	27
127 Johnson	Entire year	116	F	00
137 Johnson	Summer only	58	F	43
118 Manning	November on	503	F	43
214 Wolfe	Nov. to Dec.	25	F	39
115 Wolfe	December on	23	F	39

TABLE 9.—Cases of Pellagra Possibly Incident in Spartan Mills and Adjacent District in 1911

House	Residence Period	Pellagrin	Sex	Age
296 Brawley	March on	236*	F	36
231 College	To October	328	F	33
343 College	February on	198	M	41
122 Colton	To March	290*	F	36
137 Duncan	Spring to Dec.	238	F	38
153 Laurens	To May	91	F	34

* This case appears twice in this table because of possible origin at two different houses.

In addition to these there were five active cases of pellagra present in 1911 which may possibly have developed during the patients' residence here. Each of these is designated on the map by a circle containing a cross and the cases are enumerated in Table 9. One of them, that of Pellagrin 236, may possibly have developed at 122 Colton Street or at 296 Brawley Street, as the initial attack appeared within two months after the change of residence. At 122 Colton Street Pellagrin 236 lived in next-door relationship to two houses containing pellagrins and

TABLE 10.—Cases of Pellagra Incident in Definite Houses in Spartan Mills and Adjacent District in 1911

House	Residence Period	Pellagrin	Sex	Age
307 Arch	April on	105	F	49
342 Brawley	To May	726	F	25
145 Burnett	Feb. to Aug	98	F	27
145 Burnett	Feb. to Aug	100	F	4
182 Burnett	Entire year	1171	M	9
182 Burnett	Entire year	1172	F	5
182 Burnett	Entire year	1173	M	3
119 Choice	Entire year	206	F	47
282 College	To Sept.—death	362	F	44
331 College	To Oct.—death	329	F	60
139 Dickson	To December	203	M	44
139 Dickson	To December	204	F	37
103 Duncan	Entire year	232	F	26
154 Duncan	Entire year	235	M	14
220 Farley	To Sept.—death	1284	F	2
246 Farley	Entire year	574	F	33
328 Forest	Entire year	105	F	7
362 Forest	Entire year	66	F	35
134 Jennings	To May	555	F	21
152 Laurens	To May	93	M	6
141 Oliver	Entire year	748	F	42

this is probably the house of origin. The second patient, Pellagrin 328, moved to Inman Mills late in October 1911 and her initial erythema appeared there early in the spring of 1912. The disease may have been contracted at 331 College Street, Spartan Mills, in 1911. Another of this group, Pellagrin 198, has already been discussed in the group possibly incident in 1910. The fourth patient, Pellagrin 238, came from a neighboring mill village in the spring of 1911 and developed an initial erythema in June. The fifth case, that of Pellagrin 91,

may possibly have been incident at 153 Laurens Street, but the patient's history indicates that she had a somewhat similar illness at 120 Wolfe Street in 1910, although the record is not quite clear. The house at 120 Wolfe Street was in next-door relationship to a pellagrin at 131 Colton Street in 1910.

In 1911 there were twenty-one cases of pellagra which have been recognized as incident in definite houses in this community. These are indicated by solid red circles on the map (Fig. 6) and are enumerated in Table 10. Seven of these cases originated in houses containing another pellagrin, eight arose in houses next door to other pellagrins and six arose in houses apparently farther away than next door from an antecedent case of pellagra.

It is, of course, perfectly obvious from an examination of the map, that the number of persons in this community residing in the same house with a pellagrin early in 1911 was relatively small; that the number living next door was considerably larger and the number living farther away than next door very much larger. This was evidently true in all the years previous to 1911, according to the available records. The data for 1911 and for previous years are, however, far from complete, and we have only very meagre information concerning the nonpellagrous population in these years.

PELLAGRA IN 1912

Our field work in Spartanburg County began in 1912 and in 1913 our first house-to-house census of this community was made. This census has been repeated in 1914, 1915 and 1916. During the pellagra seasons of 1912, 1913 and 1914 we were engaged in field investigations in this community. Our records for this district in 1912 and subsequent years are, therefore, much more complete, not only in regard to pellagrins, but also in regard to the nonpellagrous population.

In our Second Progress Report we attempted to present this material so as to measure the correlation which may exist between the location of one's domicile and his liability to contract pellagra. In that study we divided the nonpellagrous population of this village, there designated as Village Sp, into three groups: first, those nonpellagrous persons residing in the same house with a pellagrin; second, those nonpellagrous persons residing next door to a pellagrin; and, third, those residing in houses farther away than next door from a pellagrin. The persons in each group were then followed to the termination of our records and the number who acquired pellagra in each group was ascertained and by reference to the total number of persons in the group, the ratio of incidence of pellagra in each group for the time covered was calculated. In the present discussion we shall pur-

sue the same general plan, modified in some details so as to adapt it better to the larger mass of data now available and to remove certain features which have been criticized by some of our fellow students and which have seemed to them to be a source of fallacy. In the present study the population of the community in each year will be considered separately, the detailed data in regard to number of persons, period of residence, period of domiciliary exposure, classification of the

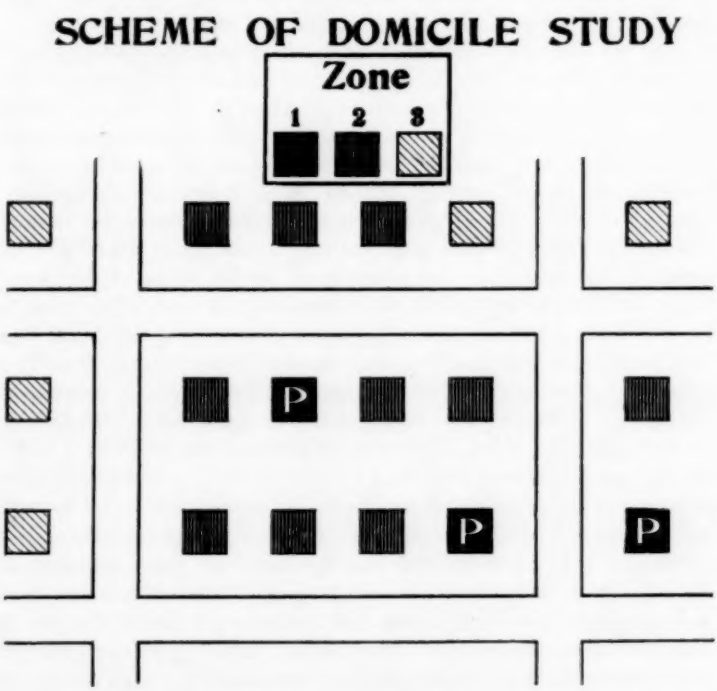

Fig. 7.—Scheme of the domicile study. The black squares with white letters indicate houses in which cases of pellagra already exist. These houses belong in Zone 1. Houses situated next door belong in Zone 2. All houses situated farther away in the same village belong in Zone 3.

population as to residence in Zone 1, Zone 2 or Zone 3, and the subsequent development of pellagra will be presented in tabular form and for each year a map will be presented showing the exact location of each recognized case of pellagra in the community.

The basic scheme of the domicile study is indicated by Figure 7, which is the same as shown in our previous report. A domicile relationship of less than fourteen days has been omitted from considera-

tion. Zone 1 includes all nonpellagrins who lived in the same house with a case of pellagra for at least two weeks in the respective year. Any case of pellagra which developed in these people later than two weeks from the beginning of the domiciliary relationship and within a reasonable period subsequent to its termination, has been credited and tabulated as a case incident in Zone 1. The reasonable period has been selected somewhat arbitrarily as three months in the warmer season, April 1 to October 1, and six months in the colder half of the year, October 1 to April 1. In all probability this interval is too short to include the incubation period of all cases of pellagra, especially in adults, but it would seem to include a considerable proportion of the cases. Obviously, poor judgment in selection of this interval would only obscure any possible correlation which might exist, so that if correlation is shown, the selection of the interval may be regarded as justified for the present purpose, at least. Zone 2 includes all nonpellagrins who lived in a house next door to a case of pellagra for at least two weeks in the respective year. A case of the disease developing in these persons later than two weeks from the beginning of the domiciliary relationship and within three months in summer or six months in winter after its termination has been credited and tabulated as a case incident in Zone 2, unless, on account of a previous residence in a house with a pellagrin within a period of three months in summer or six months in winter, it has been possible to credit the case to Zone 1. In the same way, Zone 3 includes all persons who lived in a house farther away than next door from a pellagrin for a period greater than three months in summer or six months in winter, that is, all persons not assignable to Zone 1 or Zone 2. Cases of pellagra arising in this population have been credited and tabulated as cases incident in Zone 3. In the tables it will be seen that each house has been set down and classified in one zone for the entire year or for part of the year in different zones, according to this scheme. When a family changed zones during the year, its nonpellagrous members have been counted in each zone, but when they changed houses without altering their zone relationship to pellagra, they have not been counted a second time in the same year. When pellagra developed in a person who had changed his residence without altering his zone relationship to pellagra, the case was credited to the second residence, if the erythema appeared later than two weeks after moving.

The data for the year 1912 are presented in Table 20. The records are rather incomplete because the first census was not made until late in 1913, and it was then impossible to ascertain the occupants of all the houses in 1912. It is also very probable that the data for the pellagrins themselves are somewhat incomplete. The available data show twelve

Fig. 8.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1912.

old pellagrins free from symptoms during 1912, three old pellagrins with indefinite record in 1912, and thirty-three old pellagrins with definite attack of pellagra in 1912, the disease having been acquired in a previous year or elsewhere in 1912. Several of these pellagrins changed their residence in the village during 1912 and have, therefore, been indicated on the map at more than one house. Moreover, of the persons with initial attack in 1912, two, namely, Pellagrins 1313 and 1419, moved to another house in the same year and have been designated by hollow circles at 119 Colton Street and 212 Howard Street, respectively. Of the twelve old pellagrins who were free from recurrence in 1912, four had not shown symptoms of the disease for two or more years. These

TABLE 11.—Cases of Pellagra Incident After Domiciliary Exposure in Definite Houses in Spartan Mills and Adjacent District in 1912

House	Residence in House	Zone	Residence in Zone	Pellagrin	Sex	Age
197 Brawley	Since 1910	3	1910—August, 1912	502	F	37
127 Burnett	Since winter, 1911	2	March 1, 1912-spring, 1912	1290	F	26
127 Burnett	Since winter, 1911	2	March 1, 1912-spring, 1912	1291	F	7
127 Burnett	Since winter, 1911	1	Spring, 1912-summer, 1912	1292	F	4
317 College	Since 1896	3	1896-June, 1912	197	F	38
325 College	Since March, 1912	2	June, 1912-Aug., 1912	1419	M	58
142 Colton	Since March, 1910	3	Dec., 1911-June, 1912	443	M	4
141 Farley	Since Oct., 1912	1	Fall, 1911-Nov. 29, 1912	1014*	F	6
166 Farley	Since 1905	3	Early 1911-summer 1912	803	F	41
115 Wolfe	Since Dec., 1911	1	April, 1910-June, 1912	26	F	13
115 Wolfe	Since Dec., 1911	1	April, 1910-June, 1912	27	M	6
120 Wolfe	Since 1910	2	1910-spring, 1912	1313	F	49

* The initial erythema appeared early in the spring of 1913 in this case, following an association with the grandmother, Pellagrin 503, from October until her death on Nov. 29, 1912, in the house at 141 Farley Avenue.

are Pellagrins 444, 435, 749 and 654. Although indicated in the tabulations of Table 20, they have been excluded from consideration as active centers in the domiciliary study for the year 1912. The tabulated data for 1912 also show 193 nonpellagrous persons residing in Zone 1, in the same house with a pellagrin, 589 persons in Zone 2, in houses next door to a pellagrin and 700 persons in Zone 3, in houses farther away than next door to a pellagrin. Of these, twelve contracted pellagra here in 1912, according to the available information.

Those pellagrins who suffered initial attacks in 1912 or in 1913, following within a reasonable time after termination of exposure in the first or second zone in 1912, are indicated at their respective residences in Table 20 and further information in regard to them is summarized

in Table 11. In this latter table, the period of residence in the respective houses is shown. The period of exposure in the respective zones, so far as is known, has also been indicated, this period being terminated by onset of the disease in the exposed person or by removal from the zone of exposure. Eleven of the twelve cases are indicated on the map for 1912, Figure 8, and the other one, that of Pellagrin 1014, is indicated on the map for 1913, Figure 9, inasmuch as in this case the initial erythema appeared in 1913. Of the twelve incident cases, four appeared in the population classed in Zone 1, four in Zone 2 and four in Zone 3. Pellagrin 1292, placed in Zone 1, was a girl four years of age when she suffered an initial attack at 127 Burnett Street in the summer of 1912. Her mother, Pellagrin 1290, and sister, Pellagrin 1291, were antecedent pellagrins living in the same house for some months. Her case, therefore, belongs in Zone 1. Pellagrin 1014 was another little girl, aged 6 when her initial erythema appeared early in the spring of 1913. Her grandmother, Pellagrin 503, aged 45, developed pellagra elsewhere in 1911. She and her husband, their daughter and three grandchildren moved to 118 Manning Street, Spartan Mills, later in 1911. Here they remained until July, 1912. Then the whole family moved to a farm a few miles away. At about this time Pellagrin 503 suffered a recurrent attack which gradually became more se[illegible]re. About the first of October, 1912, she was brought to her father's home, 141 Farley Avenue, Spartan Mills, and she died there on N[illegible]ember 29, 1912. At the farm her husband, Pellagrin 502, suffered [illegible] initial attack of pellagra early in November, 1912. One grandchild, the little girl here in question, Pellagrin 1014, came with her grandmother to 141 Farley Avenue, where they slept together during the grandmother's last illness, and after the death of the grandmother the little girl remained with her great grandparents, who were people in fair financial circumstances. She developed an initial erythema early in the spring of 1913, about four months after the grandmother's death, and has been designated as a case developing within six months after exposure to pellagra in the fall in Zone 1. In 1914 she suffered a mild recurrence. Pellagrin 26 was a girl aged 13 who had lived with her mother, Pellagrin 25, at 115 Wolfe Street since December, 1911. Her mother had contracted pellagra in 1910 at Columbia and since that time had rigidly excluded cornmeal from the dietary of her family. The mother suffered a recurrence about June 1, 1912, and Pellagrin 26 developed an initial erythema a few days later. Her brother aged 6, Pellagrin 27, suffered an initial attack at the same time. Both of these children have been classed as developing pellagra in Zone 1.

Among the 193 nonpellagrous persons residing in the same house with a pellagrin in 1912 there were, therefore, four who developed the disease at such a time as to be considered incident to this exposure. The indicated incidence rate in this zone in 1912 was, therefore, 2.07 per cent.

In the population of the second zone there were also four incident cases of pellagra. Pellagrin 1290, a woman aged 26 in 1912, suffered a first known attack of pellagra at 127 Burnett Street in the spring of 1912. At the same time her daughter, Pellagrin 1291, aged 7, suffered her first attack. They had moved to this house about November, 1911, and it was situated next door to 135 Burnett Street, in which Pellagrins 64 and 65 resided after March 1, 1912. Later in 1912 a second daughter, Pellagrin 1292, suffered an initial attack in the same house. She has been considered as a case incident in Zone 1. Another case in the second zone was Pellagrin 1419, a man aged 58 in 1912. He resided at 325 College Street, next door to Pellagrin 197 at 317 College Street. Pellagrin 197 developed an initial erythema in June, 1912, and Pellagrin 1419 had an initial erythema about the middle of August, 1912, within a few days after he had moved from 325 College Street to 212 Howard Street. The fourth case in the second zone, Pellagrin 1313, was a woman aged 49, who developed an initial erythema at 120 Wolfe Street in the spring or summer of 1912. She had been living there since 1910 in next-door relationship to Pellagrin 237 at 131 Colton Street and to Pellagrin 25 at 115 Wolfe Street.

The nonpellagrous population exposed in the second zone in 1912, shown in Table 20, numbered 589, so that the indicated rate of incidence in this zone was 0.68 per cent.

There were also four incident cases of pellagra in the third zone, in whom the initial attack of pellagra was developed in a house farther away than next door from an antecedent case of the disease. The first case, Pellagrin 202 at 197 Brawley Street, was a woman aged 37 who had lived in this same house since 1910. Early in August she had an erythema on the forearms, chiefly on the right, after washing clothes out-of-doors. When seen on August 30, the forearms were slightly scaly, but the eruption was not considered characteristic of pellagra. At that time she was accepted as a case of pellagra with some reservation. She was not seen again by us. Her neighbors stated that this woman was not considered to be a pellagrin by them. The second third-zone case was that of Pellagrin 197, a woman aged 38, who had an initial erythema about June 1, 1912, at 317 College Street. The diagnosis is certain in her case, as she was seen with recurrence in subsequent years. The residence in which she appears to have developed the disease was a large two-family house with

numerous occupants, some of them transient and unrecorded. The house was situated in next-door relationship to the Good Samaritan Hospital, in which pellagrins were occasionally treated. We have decided, however, not to consider the hospital as a zone center because its sanitary condition was entirely different from that of the residences. This patient has, therefore, been assigned to the third zone. The third case placed in this zone was that of Pellagrin 443, a boy aged 4, who had an initial erythema at 142 Colton Street in June, 1912, where he had lived since March, 1910. His brother, aged 9, Pellagrin 374, died of pellagra in the same house in December, 1911. The exact day of December on which Pellagrin 374 died and the exact day of June on which the erythema appeared in Pellagrin 443 are unknown. The interval is approximately six months, more than two of which belonged to the warmer season. Pellagrin 443 has, therefore, been assigned to the third zone, although there can be little question of the relation between his case and the earlier one in the family. The fourth case placed in Zone 3 was that of Pellagrin 893, a woman aged 41, at 166 Farley Avenue. She was socially intimate with Pellagrin 68 at 363 Forest Street, who frequently took meals at 166 Farley Avenue in 1912. According to the rules adopted for this study, however, Pellagrin 893 has been placed in the third zone. It will be noted that three of the four third-zone cases were those of women over 35 years of age, persons in whom intervals between recurrent attacks are prone to be most irregular, as shown in a previous paper, and in whom, we are convinced, the length of incubation period may often be much longer than that assumed for this study, namely, six months. Furthermore, women of this age are the most frequent visitors in these mill-village communities, especially visitors of the sick. The one child placed in Zone 3, Pellagrin 443, has already been considered and it is evident that his case might, with equal justice, have been assigned to Zone 1.

The total population in Zone 3 in 1912, according to Table 20, numbered 700. The indicated incidence rate in this zone was, therefore, 0.57 per cent., not significantly different from the rate in Zone 2.

THE DOMICILIARY RELATIONSHIP OF PELLAGRA IN 1913

The data of the domiciliary study for the year 1913 are presented in Table 21. The first census was made in August and September of that year and the census data are more complete than for the year 1912, but somewhat less complete than for the following years. The records of pellagra cases in 1913 are also more reliable than for 1912, but less complete and trustworthy than in 1914. There were present in 1913, according to available information, twenty-four old pellagrins free from symptoms, three old pellagrins with indefinite record in 1913

Fig. 9.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1913. The portions enclosed by the red lines were equipped with water-carriage sewer connections in 1913, the month of installation being indicated in red.

and forty-two pellagrins with active symptoms in this year, the initial attack having appeared in a previous year or elsewhere in 1913. Because some of these changed their residences within the community during 1913, one pellagrin may appear on the map in more than one place. In five instances a pellagrin living in Spartan Mills in 1913 moved into another house subsequently and is shown there as an open circle on the map, one at 331 College Street, one at 120 Dickson Street and three at 135 Choice Street, and the same three again at 146 Johnson Street. Of the twenty-four pellagrins who were without recurrence in 1913, there were ten who had been free from symptoms for two years. These are Pellagrins 444, 749, 860, 195, 1171, 1172, 1173, 435, 625 and 626; the cases are indicated in Table 21, but are excluded from consideration as active centers in the study of domiciliary relationship in 1913.

According to the data of Table 21, 427 persons lived in the same house with a pellagrin in 1913, so as to be assigned to Zone 1; 1176 persons lived next door, so as to be assigned to Zone 2 and 925 persons lived farther away than next door, so as to be assigned to Zone 3. In the entire population of the three zones there developed thirty-three new cases of pellagra in 1913, one of them within six months after termination of a first-zone exposure in 1912 and, therefore, assigned to the 1912 group, Pellagrin 1014 in Table 11. The remaining thirty-two cases of pellagra incident in 1913, together with an additional case, that of Pellagrin 1267 at 331 College Street, who developed an initial erythema early in January, 1914, in this same house where she had been living with a pellagrin since July, 1913, are enumerated in Table 12. In accordance with the available information, fifteen of these incident cases have been assigned to Zone 1, twelve to Zone 2 and six to Zone 3. The cases in each of these groups will be considered in turn.

Pellagrin 295, a woman aged 22, suffered an initial erythema in May, 1913, at 135 Burnett Street, where she had been boarding with Pellagrins 64 and 65 since March. Pellagrin 736, a girl aged 4, had an initial erythema in July, 1913, at 161 Burnett Street, where she had been living with her grandmother, Pellagrin 703, since March. Pellagrin 989, a woman aged 27, had an initial erythema in June, 1913, at 317 College Street, where she had been living with her mother for eleven years. Her mother, Pellagrin 197, had suffered from the disease since 1912. The fourth case in this zone was that of a woman, Pellagrin 1267, aged 28, who had been living at 331 College Street since June, 1912. Pellagrin 796, with active symptoms, moved into this house in July, 1913. Pellagrin 1267 developed her initial erythema early in January, 1914, at this house, and has, therefore, been assigned to Zone 1 in 1913. The fifth case was that of a woman, Pellagrin 438,

TABLE 12.—Cases of Pellagra Incident After Domiciliary Exposure in a Definite House in Spartan Mills and Adjacent District in 1913

House	Residence in House	Zone	Residence in Zone	Pellagrin	Sex	Age
127 Allen	Since 1910	3	Feb., 1911-Feb., 1913	740	M	50
135 Burnett	Since March, 1913	1	1912-May, 1913	295	F	22
145 Burnett	Since Feb., 1913	2	Feb., 1913-spring, 1913	1337	F	55
161 Burnett	Since Dec., 1912	1	March, 1912-July, 1913	736	F	4
175 Burnett	Since 1910	2	Jan., 1913-May, 1913	1312	F	19
254 College	Since Oct., 1912	3	Oct., 1912-May 1, 1913	796	F	32
272 College	Since Oct., 1912	2	Oct., 1912-May, 1913*	738	F	42
317 College	Since 1902	1	June, 1912-June, 1913	989	F	25
331 College	Since June, 1912	1	July, 1913-Jan., 1914	1267†	F	28
338 College	Since March 1, 1913	2	March 1, 1913-June, 1913	739	F	7
134 Colton	Since April, 1912	2	April, 1912-Aug. 1, 1913	742	F	41
148 Colton	Since 1902	2	June, 1912-summer, 1913	868	F	19
148 Colton	Since 1910	2	June, 1912-summer, 1913	1370	F	20
254 Farley	Since 1912	3	1912-June, 1913	583	M	67
352 Forest	Since 1908	2	Fall, 1912-Dec., 1913	904	F	25
146 Greene	Since Jan., 1913	3	Jan., 1913-June, 1913	1134	M	28
154 Greene	Since Feb., 1913	3	1909-June 1, 1913	548	F	5
198 Howard	Since 1905	2	Spring, 1912-summer, 1913	590	F	27
254 Howard	Since Oct., 1912	1	March, 1910-June 1, 1913	438	F	21
119 Jennings	Since March., 1913	2	Mar., 1913-May, 1913	650	M	10
181 Jennings	Since Jan., 1913	2	Dec., 1912-July, 1913	1167	F	21
182 Jennings	Since 1908	1	April 1, 1913-May 17, 1913	530	M	53
182 Jennings	Since 1908	1	April 1, 1913-May, 1913	1228	F	51
137 Johnson	Since Jan. 19, 1909	1	Spring, 1909-May, 1913	532	F	24
116 Milan	Since Feb., 1912	1	1911-Feb., 1913	520	F	39
147 Milan	Since spring, 1911	1	Jan., 1913-June, 1913	651	M	2
147 Milan	Since spring, 1911	1	Jan., 1913-June, 1913	652	M	4
147 Milan	Since spring, 1911	1	Jan., 1913-June, 1913	653	M	7
134 Montgomery	Since April, 1912	3	April, 1912-May, 1913	718	F	42
142 Oliver	Since 1907	2	May 1, 1911-Aug., 1913	747	F	44
2 Vaughn	Since Feb. 18, 1913	1	July, 1911-April, 1913	510	F	19
2 Vaughn	Since Feb. 18, 1913	1	July, 1911-May, 1913	512	F	38
2 Vaughn	Since Feb. 18, 1913	1	July, 1911-Sept., 1913	737	F	9

* Pellagrin 738 developed an initial erythema in June, 1913. Pellagrin 238 lived next door to her until May, 1913.

† Pellagrin 1267 developed an initial erythema early in January, 1914, at 331 College Street, where she had been living in the same house with a pellagrin since July, 1913.

aged 21. She had an initial erythema in June, 1913, at 254 Howard Street, where she had been living with her mother, Pellagrin 437, and two other pellagrins since October, 1912. Pellagrin 530 was a man aged 53, who had been living at 182 Jennings Street since 1908. On April 1, 1913, his son-in-law, Pellagrin 529, who had come down with an initial attack of pellagra at another mill village on March 28, 1913, was received into the home of the father-in-law to be cared for. On May 17, 1913, about six weeks after this pellagrin arrived, the father-in-law had his initial erythema and he died of pellagra on July 16, 1913. His wife, Pellagrin 1228, aged 52, had an initial erythema at about the same time as her husband and died early in 1914, apparently without recurrence of pellagra. These two patients, together with the one across the street, Pellagrin 1167, at 181 Jennings Street, are of some interest because they had been living in the same house for more than six years and Pellagrin 1167, their son's wife, had been living at 181 Jennings Street since September, 1912. With the entrance of a pellagrous son-in-law to their family circle, three of them promptly developed pellagra. They are also interesting because there was no blood relationship in the group of four patients. The eighth case in Zone 1 was Pellagrin 552, a woman aged 24. She had been living at 137 Johnson Street since January 19, 1909, with her husband and his mother. This mother, Pellagrin 116, had been a pellagrin since 1909. The ninth case was that of a woman, Pellagrin 520, aged 39, who had been living with her father, Pellagrin 519, at 116 Milan Street since February, 1912. The father had suffered from this disease since 1911. His daughter had an initial erythema in February, 1913, and died of pellagra in July, 1913. Pellagrins 651, 652 and 653 were brothers aged 2, 4 and 7, respectively. They lived at 147 Milan Street from early in 1911 to October 29, 1913. Their sister, aged 10, Pellagrin 654, had an initial attack in 1910, escaped recurrence in 1911 and 1912, but suffered a recurrent attack in June, 1913. Her three little brothers developed an initial erythema in June, 1913. The thirteenth case in Zone 1 was that of a girl, Pellagrin 510, aged 19, who lived at 2 Vaughn Street from February, 1913, to the spring of 1914, in the same house with Pellagrin 511, her father. He had been a pellagrin since 1911. The daughter suffered an initial erythema in April, 1913. Her mother, aged 38, had an initial erythema in May, 1913, in the same house. She is designated as Pellagrin 512. Another girl in the same family, Pellagrin 737, aged 9, had an initial erythema in the same house in September, 1913. These fifteen newly incident cases of pellagra appeared in a total recorded exposed population of 427 persons in Zone 1, so that the incidence rate of this zone in 1913 was 3.51 per cent.

The twelve incident cases assigned to the second zone will be briefly reviewed next. Pellagrin 1337, a woman aged 57, suffered an initial erythema at 145 Burnett Street in the spring of 1913. She had been living there since February, 1913. Her residence was next door to 135 Burnett Street, in which Pellagrins 64 and 65 resided throughout 1913. The second case in Zone 2, Pellagrin 1312, was a married woman aged 19, who had lived at 175 Burnett Street since 1910. During 1913 she helped nurse Pellagrin 508, next door at 181 Burnett Street, until she died in May, 1913. About this time her own hands showed an erythema for the first time. The third case was that of a woman, Pellagrin 738, aged 42, who lived at 272 College Street from October, 1912 to August, 1914, next door to 119 Manning Street, in which Pellagrin 238, with onset in 1911, lived until May, 1913. Pellagrin 738 had an initial erythema in June, 1913. The fourth case in this zone was that of a girl, Pellagrin 739, aged 7, who lived at 338 College Street from March 1, 1913 to August, 1913, next door to Pellagrins 198 and 328 at 343 College Street. The little girl developed a sore mouth and diarrhea in June, 1913, and a pellagrous erythema on July 10, 1913. The fifth case in Zone 2 was that of a woman, Pellagrin 742, aged 41, who had lived at 134 Colton Street since April, 1912. This house was next door to active pellagrins at 128 and 131 Colton Streets. She had an initial erythema about August 1, 1913. The sixth case was that of a girl, Pellagrin 868, aged 19, who had lived at 148 Colton Street since 1902. In 1912 a case of pellagra, that of Pellagrin 443, appeared next door at 142 Colton Street and remained there throughout 1913. In the summer of 1913 Pellagrin 868 had her initial erythema. The seventh case was that of an unrelated woman, Pellagrin 1376, aged 20, who had lived in this same house since 1910. She also had an initial erythema in the summer of 1913. The eighth case in Zone 2 was that of a woman, Pellagrin 904, aged 25, who had lived at 352 Forest Street since 1907. This house was in next-door relationship to Pellagrin 68 at 357 Forest Street. The first erythema of Pellagrin 904 appeared late in December, 1913, and there was a recurrent attack in April, 1914. The ninth case in Zone 2 was that of a woman, Pellagrin 590, aged 27, who had resided at 193 Howard Street since 1905. Since 1912 this house had been in next-door relationship to Pellagrin 105 at 194 College Street. The first erythema of Pellagrin 590 appeared in the summer of 1913. The tenth case was that of a boy, Pellagrin 650, aged 10. He lived at 119 Jennings Street from March, 1913, to August, 1913, next door to Pellagrin 207 at 111 Jennings Street. In his case the initial erythema appeared in May, 1913. The eleventh case in Zone 2 was that of Pellagrin 1167 at 181 Jennings Street. She was a woman aged 21, the daughter-in-law of Pellagrin

530, just across the street. Her case has been discussed along with his in the preceding paragraph. Pellagrin 747, whose case was the twelfth and last case in this zone, was a woman aged 44, who had lived at 142 Oliver Street since 1907, across the street from Pellagrin 748 at 141 Oliver Street. In her case the initial erythema appeared in August, 1913. The total population exposed in Zone 2 in 1913, according to Table 21, numbered 1176. The twelve incident cases give, therefore, an incidence rate of 1.02 per cent. in this zone in 1913.

The cases of pellagra incident in Zone 3 were six in number. Pellagrin 740 at 127 Allen Street was a man aged 50, who had lived in this house since 1910. In February, 1913, he had a definite attack of pellagra. His previous history is very incomplete and indefinite, but he did have a somewhat similar attack in 1895 and he had suffered from dysentery every summer for many years. His case has been designated as incident in 1913 in Zone 3. In the second case, that of Pellagrin 796, a woman aged 32, the initial erythema appeared at 254 College Street on May 1, 1913. She had lived there since October, 1912. From 1907 to October, 1912, she had resided at 317 College Street, where Pellagrin 197 lived at the same time. The interval between the termination of the residence in this house and the onset of initial erythema at the new residence was slightly more than six months, and the case has, therefore, been credited to Zone 3. The third case was that of a man, Pellagrin 583, aged 67, who resided at 254 Farley Avenue with his son in 1913. Just when his son moved there is not definitely known, but it was some time between September, 1912 and February, 1913. The father, Pellagrin 583, spent his time in rotation at four different residences, living with his sons and daughters, and the exact time of residence at each house was not ascertained. He suffered his initial erythema about June 15, 1913, and died of pellagra on July 25, 1913. In the absence of further information, his case has been considered as incident at 254 Farley Avenue and, therefore, in the third zone. The fourth case was that of a man, Pellagrin 1134, aged 28, who lived at 146 Greene Street from early in 1913 to August, 1913, and had an initial attack of pellagra there about June, 1913. This man was not seen by us until September, 1914, at which time he was suffering from a definite recurrent attack of pellagra. The attack in 1913 was reported to us in that year by his physician. Before coming to Spartan Mills this man had lived in the same house with Pellagrin 447 in a neighboring mill village and, according to the report of his physician in 1913, his case would seem to be properly classed as incident in this previous residence. However, his case has been designated as incident at 146 Greene Street because of some uncertainty as to the exact time he moved there. In the fifth case, that of a girl, Pellagrin 548, aged 5,

the initial erythema appeared about June 1, 1913, at 154 Greene Street, next door to the preceding case. She lived there from February, 1913, to October, 1913. Previously, from 1909 to February, 1913, she had lived at 2 Langford Street, concerning the environment of which, in 1913 and previously, we have only fragmentary information. This case might possibly be placed in Zone 2, next door to Pellagrin 1134, if the information about him were more definite. As it is, both of these cases have been placed in Zone 3. The sixth case was that of a woman, Pellagrin 718, aged 42, who objected to being interviewed. She lived at 134 Howard Street from April 10, 1912, to September, 1913. She gave a very reluctant history of erythema in May, 1913, and she has, therefore, been assigned to the third zone. Of these six cases placed in the third zone in 1913, there was one, that of Pellagrin 796, in which the history was fairly definite and complete. The other five

TABLE 13.—Comparison of the Result of the Previous Domicile Study of Spartan Mills with the Present Study of the Same Community for the Same Years

	Zone 1			Zone 2			Zone 3		
	Instances of Exposure	Incident Pellagrins	Incidence %	Instances of Exposure	Incident Pellagrins	Incidence %	Instances of Exposure	Incident Pellagrins	Incidence %
Previous study	199	14	7.04	779	3	0.38	838	6	0.72
Present study 1912	198	4	2.07	589	4	0.68	700	4	0.57
1913	427	15	3.51	1,176	12	1.02	925	6	0.65
Both years	629	19	3.06	1,765	16	0.91	1,625	10	0.62

examples are instances of unsatisfactory and incomplete records. The total exposed population of Zone 3 in 1913, according to Table 21 was 925 persons. The indicated incidence rate in this group was, therefore, 0.65 per cent., considerably less than that of Zone 2.

Spartan Mills is the same community designated as Village Sp in our Second Progress Report. Our data in relation to domicile in this village up to the end of 1913 were briefly presented in that report. At that time we possessed for this community only the data accumulated by our field study of pellagra in 1912 and 1913 and the one census made late in 1913. The records in regard to this village were considered to be much less complete than the records for the other five villages used in that study. Table 100* of that report showed a summary of the data then available, which is reproduced here in Table 13, along with

*The Archives Int. Med., 1914, **14**, 362; Second Progress Report of the Thompson-McFadden Pellagra Commission of the New York Post-Graduate Medical School and Hospital, New York, 1915, p. 85.

the summarized data of the present study for the years 1912 and 1913. It will be noted that the previous study had shown a higher incidence in the third zone than in the second zone, a relationship quite opposite to what we found in all the other five villages studied. We recognized at that time that our data for this village were less complete than for the others. Subsequent work has added much information, so that the total recorded population has been considerably increased and that in Zone 1 in 1913 has become more than double what it was before. The number of cases of pellagra incident in the second zone has increased from three to sixteen. Even our present records are not definite enough in regard to the history and environment of some of the cases, particularly those which have still been assigned to Zone 3. The time to learn and record the facts in an epidemiologic study is the time in which the events to be correlated are actually taking place. After the people have moved away, died, or forgotten the exact facts and especially the exact dates, an inquiry among the population yields only partially satisfactory results. Recognizing the shortcomings of our records for this village in 1913 and before, we undertook to make them more complete and reliable in the subsequent years. This was the more readily accomplished because the confidence of the people had been gained by the earlier work and, in addition, we already possessed the records of a preceding year to build on.

THE DOMICILIARY RELATIONSHIP OF PELLAGRA IN 1914

The data of the domiciliary study for the year 1914 are shown in Table 22. There were present in this community in that year, according to the records, thirty-two old pellagrins free from symptoms, seven old pellagrins with indefinite record for the year and fifty-one pellagrins with active pellagra in 1914, in whom the disease first appeared in a previous year, or elsewhere in 1914. On the map, Figure 10, these pellagrins are designated at the houses in which they resided and one pellagrin in some instances lived in more than one house during the year, so that the figures just mentioned do not correspond in number to the pellagrins located on the map. In four instances a pellagrin incident in Spartan Mills in 1914 moved into another house in the same community during the year and is indicated at this subsequent residence by an open circle on the map, one at 134 Milan Street, two at 120 Oliver Street and one at 172 Greene Street. There were four cases of pellagra incident in 1914, which have been indicated on the map as possibly incident in two different houses, 348 College Street and 236 Howard Street. According to the rules adopted for this domiciliary study, these four cases must be classed as incident in the second zone at 348 College Street, although the initial eruptions appeared early in

Fig. 10.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1914. The portions enclosed within red lines were equipped with water-carriage sewer connections in 1913 or 1914. For those equipped in 1914, the month of installation is indicated on this map in red.

May, after moving to 236 Howard Street on Feb. 15, 1914. Of the thirty-two pellagrins without recurrence in 1914, nineteen had remained free from symptoms for two years; these were Pellagrins 65, 443, 235, 238, 232, 195, 1292, 1255, 1171, 1172, 1173, 749, 625, 626, 1419, 261, 263, 264 and 265. These cases appear in Table 22, but have been excluded from consideration as centers in the domicile study for 1914.

TABLE 14.—Cases of Pellagra Incident After Domiciliary Exposure in a Definite House in Spartan Mills and Adjacent District in 1914

House	Residence in House	Zone	Residence in Zone	Pellagrin	Sex	Age
145 Allen.....	Since June, 1914.....	1	Spring, 1912-July, 1914.....	1289	F	9
175 Burnett.....	Since July 1, 1914....	1	July 1, 1914-July 23, 1914..	1026	F	1⅔
135 Choice.....	Since Dec. 1, 1913	1	Jan., 1913-June 2, 1914.....	1005	F	31
264 College.....	Since March 1, 1914...	2	March 1, 1914-spring, 1914..	1174	M	36
348 College.....	Since Dec. 18, 1913....	2	Dec. 18, 1913-Feb. 15, 1914*..	917	F	30
348 College.....	Since Dec. 18, 1913....	2	Dec. 18, 1913-Feb. 15, 1914*..	918	M	10
348 College.....	Since Dec. 18, 1913....	2	Dec. 18, 1913-Feb. 15, 1914*..	919	M	9
348 College.....	Since Dec. 18, 1913....	2	Dec. 18, 1913-Feb. 15, 1914*..	920	M	5
116 Colton.....	Since March, 1914.....	1	Jan., 1914-May 8, 1914.....	913	F	6
116 Colton.....	Since March, 1914.....	1	Jan., 1914-June 10, 1914.....	939	F	42
116 Colton.....	Since March, 1914.....	1	Jan., 1914-summer, 1914....	1300	F	21
127 Colton.....	Since 1908.....	2	Spring, 1909-summer, 1914..	1389	M	50
128 Colton.....	Since Feb. 15, 1914....	2	Feb. 15, 1914-summer, 1914..	1305	F	36
138 Colton.....	Since 1909.....	2	June, 1912-summer, 1914...	1310	F	9
148 Colton.....	Since 1902.....	1	Summer, 1913-spring, 1914..	912	F	39
134 Jennings.....	Since March 15, 1914..	2	March 15, '14-March 30, '14.	944	F	23
159 Laurens.....	Since Nov. 15, 1912....	2	Summer, 1913-May 1, 1914..	940	F	66
142 Manning.....	Since June, 1911.....	3	Jan., 1913-June, 1914.....	1269	F	33
114 Oliver.....	Since Dec., 1913.....	2	Dec., 1913-Jan. 21, 1914.....	977	F	22
114 Oliver.....	Since Dec., 1913.....	2	Dec., 1913-Jan. 21, 1914.....	1259	M	4

* Pellagrins 917, 918, 919 and 920 moved out of Zone 2 on Feb. 15, 1914. They all developed the initial erythema in the period from May 1 to May 14, 1914.

According to the data of Table 22, there were 427 nonpellagrous persons living during 1914 in the same house with a pellagrin in whom the disease was active in either 1913 or 1914, or both years; these exposed nonpellagrous individuals have been assigned to Zone 1. There were 1,144 nonpellagrous persons living not in a house in Zone 1, but next door to such a house, so as to be assigned to Zone 2 and there were 1,050 persons living farther away than next door from any pellagrin with active attack in 1913 or 1914, so as to be assigned to Zone 3. In the entire population of the three zones there developed twenty new cases of pellagra in 1914. These are enumerated in Table 14.

The cases of pellagra incident in Zone 1 numbered seven. Pellagrin 1289 at 145 Allen Street was a girl aged 9, who had lived in this house with her mother, Pellagrin 328, for only about two weeks when she developed an initial erythema in the summer of 1914. Previously the family had been living outside the community. This case is classed as incident at 145 Allen Street with some reservation, because of the very short period of residence previous to onset in this house. The second case in Zone 1, at 175 Burnett Street, was a girl baby, Pellagrin 1026, aged 20 months, who developed an initial erythema on July 23, 1914. She was a daughter of Pellagrin 529 and had lived at 182 Jennings Street in 1913, where her father lay ill with pellagra and both her maternal grandparents, Pellagrins 530 and 1228, contracted the disease. After the death of her grandfather and father, she lived with her pellagrous grandmother at 120 Dickson Street from August, 1913, to February, 1914, when her grandmother died, and at 186 College Street in next-door relation to Pellagrins 116 and 552 from February to May 15, 1914. From May 15 to July 1 she was at 174 Burnett Street, another house in Zone 2. She then came to 175 Burnett Street on July 1 and developed an initial erythema on July 23. At this last house she was being cared for by Pellagrin 1312 and her case has, therefore, been designated as incident there in Zone 1, although with some reservation, because of the short period of her residence there. The disease did not recur in 1915 or 1916 in this little child. The third case in Zone 1, at 135 Choice Street, was that of a woman, Pellagrin 1005, aged 31, who developed an initial erythema on June 2, 1914. She had four young pellagrous children, Pellagrins 651, 652, 653 and 654, one having acquired the disease in 1910 and the others in 1913. The family moved to 134 Milan Street in the fall of 1914. Four of the five pellagrins in this family suffered attacks in 1914, three of them again in 1915, but they all escaped without recurrence in 1916. The fourth case in Zone 1, at 116 Colton Street, was that of a woman, Pellagrin 939, aged 42, who had lived in this house since 1910. Her daughter, Pellagrin 444, aged 10 in 1914, had been a pellagrin since 1907 and her husband had died of pellagra in 1910. The little girl, Pellagrin 444, had a recurrent attack of pellagra in 1914 and in the same house her mother, Pellagrin 939, and her two sisters, Pellagrin 913, aged 6, and Pellagrin 1309, aged 20, suffered initial attacks of the disease, all in Zone 1. The seventh case in Zone 1, at 148 Colton Street, was that of a woman, Pellagrin 912, aged 39, who had lived in this same house since 1902. Her daughter, Pellagrin 868, and an unrelated woman, Pellagrin 1376, both pellagrins since 1913, were living in the same house.

The total exposed population in Zone 1, according to Table 22, was 427 persons, so that the seven incident cases indicate an incidence rate of 1.64 per cent. in this zone in 1914.

There were twelve incident cases of pellagra in the population of the second zone in 1914. Pellagrin 1174 at 264 College Street was a man aged 36, who had lived there since March 1, 1914, next door to Pellagrin 738 at 272 College Street. Previously, he had resided in other mill villages in houses, the environment of which has not been examined. In his case the initial erythema appeared in the spring or summer of 1914 at 264 College Street and he has been considered as incident there, with some reservation. Pellagrins 917, 918, 919 and 920, a woman aged 30, and three sons, aged 10, 9 and 5, respectively, all developed an erythema for the first time within two weeks, from May 1 to May 14, 1914, at 236 Howard Street. They had lived in this house since February 15, 1914. From 1909 to September, 1913, this family had lived in one house at a neighboring mill village. A portion of this same house was occupied by another family from 1911 to July 1, 1913, and the wife in this family, Pellagrin 593, had an initial attack in 1912, so that Pellagrins 917, 918, 919 and 920 were in the same house with a pellagrin up to July 1, 1913. They were also next door to Pellagrin 282 in this same village until they moved away in September, 1913. From September to December 18, 1913, they lived in Spartanburg in a house not near pellagrins, so far as we have been able to ascertain. From December 18, 1913 to February 15, 1914, they lived at 348 College Street, next door to Pellagrin 726 at 344 College Street, Pellagrin 198 at 343 College Street and Pellagrin 747 at 142 Oliver Street. During their residence here, the construction work of installing the water-carriage sewer system and the removal of the surface privies was performed in this section, the sewer connections being made in January, 1914. In all four cases in this family the initial erythema developed within three months after moving from this house to 236 Howard Street and within such a brief interval that no one case can be placed in Zone 1 in relation to any of the others, according to the rules of this study. These cases are, therefore, considered as incident in Zone 2 within three months after exposure at 348 College Street, which, considering the season of the year, may not be an unreasonably long incubation period even for young children. The other possibility we have had in mind was that the mother may have contracted pellagra the previous year without recognizing it and that the children were then secondary to her in Zone 1 at 236 Howard Street in 1914. This appeared to be the more plausible explanation of these cases, but proof of it could not be obtained.

The sixth case in Zone 2, at 127 Colton Street, was that of a man, Pellagrin 1389, aged 53, a fairly well-to-do carpenter who had lived at this house since 1908, next door to pellagrins at 116, 119 and 131 Colton Street. He appeared to be very well nourished and weighed

more than 200 pounds. He indulged somewhat freely in alcohol, as we have frequently observed to be the case in other instances of pellagra in well-to-do men. In his case the erythema seems to have appeared in the summer of 1914, although it may possibly have been a year earlier. The disease recurred in 1915, according to his history, and he was seen with typical eruption in 1916. His case has been classed as certainly incident in the second zone, and probably in 1914. The seventh case, at 128 Colton Street, was that of a woman, Pellagrin 1305, aged 36, who had lived there since Feb. 15, 1914. Previously she had lived in the mountains of North Carolina. At 128 Colton Street she was next door to pellagrins at 131 and 134 Colton Street. During the summer of 1914 she had a mild erythema, to which she paid little or no attention. She was then pregnant. In February or early in March, 1915, she had a severe recurrence. The eighth case, Pellagrin 1310 at 138 Colton Street, was a girl aged 9, who had been living in this house since 1909. In 1914 her residence was next door to active pellagrins at 134 Colton Street and 160 Burnett Street. She had a mild attack of pellagra in the summer of 1914 and a recurrence in 1915. The ninth incident case in Zone 2, at 134 Jennings Street, was that of a woman, Pellagrin 944, aged 23. She moved to this house from Greenville County, S. C., on March 15, 1914, and her initial erythema appeared on March 30, 1914, so that her case is just barely classifiable as incident in this house, according to the plan of this domicile study. Her mother, Pellagrin 1255, lived with her at the former residence and here also. The mother had an initial attack in 1910 with recurrence in 1911, but had been free from recurrence since that time. For that reason, she cannot be considered as a center of distribution in this domicile study. Next door, at 135 Burnett Street, Pellagrin 64 had active pellagra in 1914, so that this new case, Pellagrin 944, has been classed as incident in the second zone. This has been done with considerable reservation because of the very brief period of residence. It seems very probable that the disease was actually contracted at the previous residence in Greenville County, but information in regard to the situation there was not obtainable. The tenth case, at 159 Laurens Street, was that of a woman, Pellagrin 940, aged 66, who had lived in this house since November 15, 1912, next door in 1913 and 1914 to Pellagrin 328 at 153 Laurens Street, and to Pellagrins 868 and 1376 at 148 Colton Street. She developed an initial erythema on May 1, 1914. These two houses on Laurens Street, 153 and 159, were not sewered. In the eleventh and twelfth cases, those of Pellagrin 1259, a boy, aged 5, and his mother, Pellagrin 977, aged 22, initial attacks of pellagra occurred about the same time in June, 1914, at 120 Oliver Street, shortly after the mother and boy moved there from 114 Oliver

Street. They lived at 114 Oliver Street from December, 1913, to June, 1914, next door to 334 Forest Street, in which Pellagrin 70 suffered a recurrent attack beginning August, 1913 and ending in death on Jan. 21, 1914. Both this boy and his mother suffered an initial attack about the same time and both have, therefore, been classified in the second zone.

The total exposed population in Zone 2, according to Table 22, numbered 1,144 persons. With twelve incident cases in this population, the indicated incidence rate for Zone 2 in 1914 was 1.05 per cent.

In the third zone only one incident case arose in 1914, that of Pellagrin 1269. She was a woman aged 33 who had lived at 142 Manning Street since June, 1911, and was still there in 1916. A physician informed us in 1914 that he had attended her in childbirth in August, 1913, and that in June, 1914, while talking with her on the street, he had observed a typical pellagrous erythema on her hands and forearms. She was interviewed by us at her home in August, 1913, June, 1914, August, 1915, and August, 1916. Our records show that a son was born in June, 1913, (not August) and another son in March, 1916. We have not been able to obtain any history of pellagra from her nor have we seen any signs of it. In 1914, when she was said to have pellagra, her weight was approximately 200 pounds. Her mother, Pellagrin 237 at 131 Colton Street, had been a pellagrin for many years and she was at her house frequently. Next door, at 150 Manning Street, Pellagrins 1171, 1172 and 1173 had been living for some years, but they had been free from recurrence of the disease since the initial attack in 1911 and have not been considered as centers of distribution in 1914. The case of Pellagrin 1269 has, therefore, been designated as incident in the third zone in 1914, with considerable reservation, especially in regard to the diagnosis.

According to the data of Table 22, the total population of Zone 3 in 1914 numbered 1,050 persons, so that the indicated incidence rate in this zone in 1914 was 0.10 per cent. The more complete data of 1914 have served to reduce the incidence in Zone 3 practically to the vanishing point.

On the map of the community for 1914, Figure 10, the districts sewered in 1913 are enclosed in red lines without any included date. The sections sewered in 1914 are also enclosed in red lines and the month in which the sewer installation was made is indicated in each such enclosed section. If one cares to look up in the text the incident cases of pellagra located on this map, with particular attention to the period of exposure and the exact date of initial erythema, he may already perceive a distinct indication of the influence of the sewer installation on the incidence of pellagra.

THE DOMICILIARY RELATIONSHIP OF PELLAGRA IN 1915

The data of the domiciliary study for the year 1915 are shown in Table 23. There were present in 1915 in this community, according to the records, forty-one old pellagrins free from symptoms. Of this number there were twenty-one who had remained free from recurrence for two years. These were Pellagrins 1337, 893, 194, 1283, 235, 232, 548, 493, 1419, 435, 1292, 1171, 1172, 1173, 654, 749, 747, 261, 263, 264 and 265. They are indicated in Table 23, but have been excluded from consideration as active centers in the domicile study for 1915. There were eight old pellagrins with indefinite record for the year and fifty-four with active attack in 1915, the initial attack having occurred in a previous year or elsewhere in 1915. The houses in which these pellagrins lived during 1915 are indicated in Figure 11. Pellagrin 1282,

TABLE 15.—CASES OF PELLAGRA INCIDENT AFTER DOMICILIARY EXPOSURE IN SPARTAN MILLS AND ADJACENT DISTRICT IN 1915

House	Residence in House	Zone	Residence in Zone	Pellagrin	Sex	Age
127 Burnett.....	Since April, 1915.....	2	Nov., 1914 - June, 1915.....	1302	F	20
152 Burnett.....	Since Nov., 1914.....	1	Birth - June 1, 1915.....	1301	M	3
175 Burnett.....	Since 1910.....	1	May, 1913 - summer, 1915...	1311	M	5
265 College.....	Since Dec., 1914.....	1	Birth - May 28, 1915.....	1276	F	2
334 College.....	Since Nov., 1914.....	2	May 15, 1914 - July, 1915...	1280	F	28
119 Colton.....	Since 1912.....	1	Spring, 1912 - June, 1915....	1314	M	53
110 Greene.....	Since March, 1915.....	2	March - June 15, 1915.....	1279	F	37
172 Greene.....	Since Oct., 1914.....	1	May 1, 1914 - June, 1915.....	1282	F	35
217 Greene.....	Since Jan., 1915.....	2	June 10, 1914 - May, 1915....	1285	F	17
198 Jennings.....	Since May, 1913.....	2	May, 1913 - April, 1915.....	1336	F	31

incident at 172 Greene Street in 1915, moved to 217 Greene Street in September, 1915, and is designated there by an open circle on the map. A second case, Pellagrin 1285, incident at 217 Greene Street, moved in September, 1915, to 347 College Street.

According to Table 23, there were 439 nonpellagrous persons living during 1915 in the same house with a pellagrin in whom the disease was active either in 1914 or 1915, or both years, and these exposed nonpellagrous individuals have been assigned to Zone 1. There were 1,174 nonpellagrous persons living next door to such a house, so as to be assigned to Zone 2, and there were 1,069 persons farther away than next door from any pellagrin with active attack in 1914 or 1915, so as to be assigned to Zone 3. In the entire population of the community there appeared ten new cases of pellagra, which have been designated

Fig. 11.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present in 1915. The sewered districts are enclosed within red lines.

as cases incident in this community in 1915, according to the assumptions made for this study. These ten cases are enumerated in Table 15.

Five of these cases fall into Zone 1. Pellagrin 1301 at 152 Burnett Street was a boy aged 3, who had lived in this house since November, 1914. He was born at 343 College Street in 1912, moved to 160 Burnett Street in April, 1914, and to 152 Burnett Street in November, 1914. He had a severe intestinal disturbance in May, 1915, and his feet "turned brown" about June 1 and remained so for about two weeks. He was taken to the Pellagra Hospital of the U. S. Public Health Service for examination, where the condition was considered as probably pellagra, but a positive diagnosis could not be made. There was no recurrence in 1916. The diagnosis in this case appears, therefore, rather uncertain. His father, Pellagrin 198, lived in the same house and suffered a recurrent attack of pellagra in 1915, so that the case of the child has been assigned to Zone 1. Pellagrin 1311 at 175 Burnett Street was a boy aged 5, who had lived in this house since 1910 with his mother, Pellagrin 1312. In the summer of 1915 an erythema appeared on the dorsal surfaces of his feet. He was not seen by a physician, so far as we are aware, and the nature of this erythema may be questioned. In 1916 he remained free from manifestations of pellagra. He has been tentatively accepted as a pellagrin incident in Zone 1 in 1915. The third case in Zone 1 was that of Pellagrin 1276, a girl aged 2, who resided at 265 College Street from December, 1914 to June, 1915. Her mother, Pellagrin 987, had an initial attack in May, 1908, with recurrence every year. From March, 1914 to July, 1914, the family lived at 102 Greene Street in Spartan Mills. Then they went to a farm in Tennessee. About Christmas time, 1915, they returned to this community and lived at 265 College Street. Here the mother suffered a very severe recurrent attack of pellagra about May 1, in which there was marked mental disturbance. There was no one competent to look after the household and, according to the neighbors, the house and premises were in a filthy condition. In the latter part of May the mother was committed to the Columbia State Hospital for the Insane. The baby, Pellagrin 1276, developed a sore mouth on May 19, and an erythematous eruption on the backs of the hands, forearms and feet, accompanied by diarrhea, on May 28, 1915. She was received as a patient into the Pellagra Hospital of the U. S. Public Health Service on June 19, 1915, where she remained until April 16, 1916. The mother remained in Columbia only about six weeks, was brought back to Spartan Mills on July 1, 1915, and on July 10, 1915, was taken from there to her mother's home in Tennessee to die, according to the neighbors. She had to be carried to the train. In 1916 both mother

and child visited Spartan Mills and both appeared to be fully recovered. We have no further record of them after April, 1916. The case of the child, Pellagrin 1276, has been designated as incident in Zone 1 at 265 College Street in 1915. The fourth case in Zone 1, at 119 Colton Street, was that of a man, Pellagrin 1314, aged 53, who had lived there since 1912. Previously, from 1910 to 1912, he resided at 120 Wolfe Street. He was away from home during the entire month of February, 1915, when he was employed in the Du Pont Powder Works at Du Pont, Virginia. He then returned home and resumed his regular occupation as a carpenter. His wife, Pellagrin 1313, had an initial attack of the disease in 1912 and suffered recurrence in 1914 and 1915. The husband suffered an initial erythema in June, 1915, and his case has been designated as incident in Zone 1 at 119 Colton Street. The fifth case in Zone 1, at 172 Greene Street, was that of a feeble-minded woman, Pellagrin 1282, aged 35. Definite pellagrous eruption was observed on her forearms by us, August 6, 1915, and this "sunburn" seems to have appeared in June, 1915. The patient was rather uncommunicative and denied ever having any symptoms or signs of pellagra, nor was it possible to gain the information from other members of the household. Her mother, Pellagrin 940, lived in the same house. In fact, they had lived together for many years at various houses. In 1914 they resided at 159 Laurens Street, where the mother had a first recognized attack of pellagra. It seems very doubtful whether Pellagrin 1282 had a first attack in 1915 or not. Her mental attitude and that of the family justifies a strong suspicion that this woman may have had pellagra for several years. In the absence of definite history, the observed pellagrous eruption in 1915 has to be taken as the first erythema. The family lived at 172 Greene Street from October, 1914, to September, 1915, and the case of Pellagrin 1282 has, therefore, been designated as incident in Zone 1 in this house in 1915, although with considerable reservation.

Of these five cases in Zone 1, there were only three in which the diagnosis may be considered certain, those of Pellagrins 1301 and 1311 being regarded as doubtful cases. Of the three definite pellagrins, one, Pellagrin 1282, may have had the disease in previous years. There remain two cases incident in Zone 1 in this community in 1915 with a fair degree of certainty, Pellagrin 1276 at 265 College Street and Pellagrin 1314 at 119 Colton Street. The total exposed nonpellagrous population in Zone 1 in 1915 numbered 439 persons, so that the origin of five cases in this zone gives an indicated incidence rate of 1.14 per cent. for 1915. One of these incident cases arose in the district adjacent to Spartan Mills proper, in which the first zone population in 1915 numbered forty-seven persons, giving an incidence rate of 2.13 per

cent. The other four cases appeared in the mill district proper in a total of 392* exposed persons, giving an incidence rate of 1.02 per cent. in the first zone for 1915.

In Table 15 the five cases of pellagra incident in Zone 2 in 1915 are enumerated. Pellagrin 1303 at 127 Burnett Street was a woman aged 20. She was married, but resided with her mother, a widow. The family lived in Greenville, S. C., from May, 1914 to November, 1914. Then they moved to Spartanburg County to Mill Village Sa., where they lived next door to Pellagrins 1321 and 1322, from November, 1914, to the spring of 1915. The mother and most of the family moved to 127 Burnett Street, Spartan Mills, in February, 1915, but the one daughter, Pellagrin 1303, and her husband and child remained at the former residence until April, 1915, and she, Pellagrin 1303, developed a very sore mouth, accompanied by pyrosis, in March at this former residence. In April she also came to 127 Burnett Street and early in June the pellagrous erythema appeared on her hands. This latter residence was next door to active pellagrins in 118 and 134 Jennings Street and 135 Burnett Street, so that, under the arbitrary rules of this domicile study, the case of Pellagrin 1303 has been designated as incident in Zone 2 at 127 Burnett Street. There is considerable probability, however, that the disease was actually contracted at the previous residence. The second case in Zone 2, at 334 College Street, was that of a woman, Pellagrin 1280, aged 28, who had the earliest recognized erythema early in June, 1915. From November, 1913, to November, 1914, she had lived at 3 G Street at Inman Mills, in next-door relationship to Pellagrin 934, after May 15, 1914. In the spring of 1914 she had severe digestive disturbance and her doctor told her he thought she had pellagra. An erythema was not observed in that year. She became pregnant in September, 1914. The family moved to 334 College Street, Spartan Mills, in November, 1914. Early in the spring of 1915 the patient had "scalded mouth" and the pellagrous erythema appeared early in July, about two weeks after childbirth, which occurred on June 21, 1915. The eruption was seen by us on August 6, 1915. In September she was admitted as an outpatient for dietetic treatment at the Pellagra Hospital of the U. S. Public Helath Service, where the diagnosis was confirmed. She took meals there for three or four months. In March, 1916, she moved to Chesnee, S. C., where she suffered a recurrent attack of pellagra in July, 1916. At 334 College Street she lived next door to active pellagrins at 338 College Street and at 120 Oliver Street. Her case has, therefore, been designated as incident in the second zone at this residence, although there is a strong

*This number includes four persons living with Pellagrins 436, 437 and 438, at 254 Howard Street, which was an unsewered mill house.

suspicion that the disease was contracted at Inman Mills in 1914, and the incubation period prolonged on account of pregnancy. The third case in Zone 2, at 110 Greene Street, was that of a woman, Pellagrin 1279, aged 37. She lived there since March, 1915, having resided previously in a neighboring district of Spartanburg City. Her residence at 110 Greene Street was in next-door relationship to 265 College Street, in which Pellagrin 987 had a severe recurrence, with mental involvement in 1915. Neither of these residences was screened. The daughter of Pellagrin 1279, aged 7, had suffered an initial attack of pellagra in 1913, without any recurrence in 1914 or 1915. She cannot be considered as a center for distribution of pellagra in 1915. The financial condition of this family had improved very much since 1913. In that year the husband and father was in legal difficulties and unable to contribute anything to the support of his wife and three small children. The wife worked in the mill and the children were cared for by neighbors. In 1915 the husband was working steadily in the mill and the wife was caring for the home and family. Pellagrin 1279 had an initial erythema on June 15, 1915, and her case has been designated as incident in Zone 2 at 110 Greene Street in 1915, although the brief period of residence, March to June 15, suggests the possibility that the disease may have been contracted at the previous residence outside of this community. The fourth case in Zone 2, at 217 Greene Street, was that of a married woman, Pellagrin 1285, aged 17. She lived at 148 Colton Street from 1901 to 1914, her mother and sister being pellagrins in this same house. In the spring of 1914 she married and went to North Carolina, returning in June, when she stayed about a week at her mother's house. She then lived in several different houses during the next six months, always next door to a pellagrin, but did not again live in the same house with an active pellagrin. About January 1, 1915, she moved to 217 Greene Street. This house had just been vacated by Pellagrin 1293, who had a prolonged recurrent attack in 1914, and it was just across the street from Pellagrins 328 and 1289 at 216 Greene Street and from the new residence of Pellagrin 1293 at 206 Greene Street. Pellagrin 1285 gave birth to a boy on Feb. 14, 1915. An initial erythema appeared some time in May, 1915. Her case has been designated as incident in the second zone at 217 Greene Street. The fifth case in Zone 2 was that of a woman, Pellagrin 1336, 31 years old, who had resided at 126 Jennings Street since May, 1913. This house was next door to active pellagrins at 118, 134 and 135 Jennings Street and 135 Burnett Street. In her case the initial erythema appeared in April, 1915, and she was seen by us with a recurrent eruption in August, 1916. This patient had spent a week early in March, 1915, at the home of her father on a farm. He

had been a pellagrin since 1909 and another of his daughters, aged 16, had an initial attack of pellagra in 1914. Early in March his wife, mother of Pellagrin 1336, was severely ill with gastro-intestinal disturbance and it was at this time that Pellagrin 1336 spent the week there. If she had spent two weeks at her father's house at this time, her case would have to be designated as incident there in the first zone, but according to the rules we are following in this study, her case has been designated as incident in Zone 2 at 126 Jennings Street.

In this group of five cases all were women, and the domicile relationship of pellagra was obscured somewhat by changes from one house to another and by pregnancy and childbirth. The cases of Pellagrins 1279 and 1285 seem to be most definitely incident at the residences designated. The exposed population in Zone 2 in 1915 numbered 1,174 persons, so that five incident cases in this zone give an incidence rate of 0.43 per cent. for the year. Of this number, 996 * persons lived in the mill village proper, in which four cases of incident pellagra appeared in 1915, giving an incidence rate of 0.40 per cent. In the district adjacent to Spartan Mills there were 178 persons living in Zone 2 in 1915, with one incident case of pellagra, giving an incidence rate of 0.56 per cent. for that section.

There were no known cases of pellagra incident in Spartan Mills in 1915 in Zone 3, that is in a house farther away than next door from a pellagrin active either in 1914 or 1915, or both years. The total exposed population in this zone in 1915 numbered 1,069 persons, of whom 856 † lived in the mill village proper and 213 resided in the adjacent district. The incidence rate among them for 1915 was zero.

THE DOMICILIARY RELATIONSHIP OF PELLAGRA IN 1916

The data for the domiciliary study for 1916 are shown in Table 24, and the location of domicile of each pellagrin is indicated on the map, Figure 12. In 1916 sixty-five old pellagrins free from symptoms were present in this community. This number includes thirty-four pellagrins who had remained free from recurrence for two years. These are Pellagrins 64, 1267, 1167, 796, 893, 913, 939, 868, 912, 204, 1283, 1287, 235, 1174, 904, 232, 548, 493, 918, 919, 920, 1292, 1269, 1171, 1172, 1173, 654, 1005, 749, 747, 261, 263, 264 and 265. They appear in Table 24, but have been excluded from consideration as active centers in the domicile study for 1916. This number does not include Pellagrins 1382 and 1383 at 138 Duncan Street, who moved into Spartan Mills in August, 1916, too late to be considered in the studies for

* This number includes thirteen persons living in unsewered mill houses at 112 Farley Avenue, 122 Farley Avenue and 264 Howard Street.

† This number includes twenty-nine persons living in unsewered mill houses at 116 Farley Avenue, 122 Farley Avenue and 316 Howard Street.

Fig. 12.—Map of Spartan Mills and the district adjacent to it, showing the location and character of all known cases of pellagra present up to Aug. 15, 1916. The sewered districts are enclosed within red lines.

that year. They have, however, been indicated in the tabulation and on the map. There were also present three old pellagrins with indefinite record for the year and thirty-two with active attack in 1916, the initial attack having occurred in a previous year or elsewhere in 1916. Pellagrins 1371 and 1372, who moved into Spartan Mills in August, 1916, have been excluded from this number, although they have been indicated on the map at 111 Greene Street. The houses in which all these pellagrins resided are indicated on the map for this year, Figure 12. Two pellagrins incident in this community in 1916 moved to other houses within the district subsequently and are designated at the second residence by an open circle in each instance. Pellagrin 1351, who was incident at 217 Greene Street, subsequently moved to 216 Greene Street and Pellagrin 1353, who was incident at 1 Langford Street, subsequently moved to 181 Jennings Street.

TABLE 16.—Cases of Pellagra with Onset Previous to Aug. 15, 1916, Incident After Domiciliary Exposure in Spartan Mills and Adjacent District in 1916

House	Residence in House	Zone	Residence in Zone	Pellagrin	Sex	Age
134 Colton	Since June 30, 1915	1	June 30, 1915-June, 1916	1377	F	18
201 Greene	Since Dec. 22, 1914	2	Nov., 1915-June, 1916	1399	F	11
201 Greene	Since Dec. 22, 1914	2	Nov., 1915-June, 1916	1400	F	13
217 Greene	Since Sept. 2, 1915	1	May 1, 1914-June, 1916	1351	F	21
1 Langford	Since Nov. 1, 1915	1	May, 1915-April, 1916	1353	F	33

According to Table 24, there were 215 nonpellagrous persons living during 1916 in the same house with a pellagrin in whom the disease was active either in 1915 or 1916, or both years; these persons have been assigned to Zone 1. There were 1,006 nonpellagrous persons living next door to such a house, so as to be assigned to Zone 2, and 940 persons living farther away than next door from any pellagrin with active attack in 1915 or 1916, so as to be assigned to Zone 3. Those instances in which domiciliary relationship began later than July 1, 1916, have been excluded from consideration in the present study. In the entire population of the community, five incident cases of pellagra appeared in 1916, up to the time of our survey in August. These incident cases of pellagra are enumerated in Table 16.

Three of these cases fall into Zone 1. Pellagrin 1377 at 134 Colton Street was a woman aged 18. She had lived with her father at 128 Burnett Street from December, 1914, to June 30, 1915. She then married and came to live with her husband and his mother at 134 Col-

ton Street. She bore a child on April 21, 1916, and the initial pellagrous erythema appeared about July 15, 1916. Her mother-in-law, Pellagrin 742, suffered attacks of the disease in 1913, 1914 and 1915, but escaped without attack in 1916. Another woman living in the same house, Pellagrin 1376, aged 23, had an initial attack in 1913 and suffered recurrence every year. In 1916 the erythema recurred in March and there was a further exacerbation in June. This woman had lived in this house since September, 1915. Pellagrin 1377 has, therefore, been assigned to Zone 1. It may be noted, however, that 134 Colton Street, which was a sewered house, was in next-door relationship to 131 Colton Street, an unsewered house, in which Pellagrin 237 had resided for many years and in which she had a recurrent attack of pellagra late in 1915. The second case in Zone 1, at 217 Greene Street, was that of a married woman, Pellagrin 1351, aged 21. She had lived with her grandmother, Pellagrin 940, for several years and they resided at 172 Greene Street from October, 1914 to September, 1915. In September, 1915, they moved to 217 Greene Street. Pellagrin 1351 gave birth to a child on Sept. 17, 1915. In her case, the initial pellagrous erythema appeared in June, 1916. In the following month she separated from her grandmother and took the house across the street at 216 Greene Street. The third case in Zone 1, at 1 Langford Street, was that of a married woman, Pellagrin 1353, aged 33. Her husband had been a patient in the State Hospital for the Insane since January, 1914, and she was a factory worker, but did not work in the cotton mill. During 1915 she boarded with Pellagrin 16 at 304 Forest Street, and in 1916 she was boarding with this same family at 1 Langford Street. They moved on Nov. 1, 1915. Pellagrin 16 had an initial attack in 1908 and recurred every year to and including 1916. Pellagrin 1353 had an initial erythema on April 1, 1916, was admitted as a house patient at the Pellagra Hospital on June 3, 1916, and discharged on August 3, 1916. She then went to board at 181 Jennings Street.

The total population of Zone 1 in 1916 was 215 persons. The three incident cases in this zone give, therefore, an incidence rate of 1.40 per cent. in 1916. Two of these incident cases appeared in the district adjacent to Spartan Mills proper, in which district the population in Zone 1 numbered forty-four persons in 1916, giving an incidence rate of 4.54 per cent. One of the three incident cases, that of Pellagrin 1377 at 134 Colton Street, appeared within the sewered district of Spartan Mills proper. The population of Zone 1 in the mill village proper in 1916 numbered 171* persons, so that the indicated incidence rate in 1916 was here 0.58 per cent.

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*This number includes four persons in the family of Pellagrins 437 and 438 at 254 Howard Street. This house, although in the mill village proper, was one of a small group of houses which have never been sewered.

The two incident pellagrins in Zone 2 in 1916 were sisters, Pellagrins 1399 and 1400, aged 11 and 13, respectively. They had lived in the large house at 201 Greene Street since Dec. 22, 1914. This family was not of the usual mill-village class. The children were receiving education and those at work were engaged as telephone operators and clerks. The house was a large one, privately owned, and had been equipped with water supply and sewer before the mill village proper was sewered. The house was not screened. In June, 1916, the two girls developed an initial pellagrous erythema at the same time. The diagnosis of pellagra was made by the family physician and they were admitted as outpatients at the Pellagra Hospital of the U. S. Public Health Service. During September and October, 1915, their aunt, Pellagrin 880, had been at their home on a visit. She had annual attacks of pellagra from 1912 to 1914, inclusive, but has had none since. The interval between her departure and the onset of erythema in the children was more than six months. The house next door, 217 Greene Street, was occupied by active pellagrins in 1915 and also in 1916. This house, 217 Greene Street, was not sewered, but was provided with an outhouse privy, which had been sanitary according to the requirements of the health authorities in 1914. Since then it had gradually become dilapidated. When inspected on Aug. 16, 1916, it was found in a filthy condition. The screen was broken out of the ventilator opening, the hinged drop cover at the back was broken off and excrement openly exposed and covered with flies. The surface of the ground was polluted for a considerable distance at the back of the outhouse. This outhouse was located about 25 yards back of 217 Greene Street and about 30 yards from the unscreened windows of the dining-room and kitchen of 201 Greene Street. Each of these houses had incident cases of pellagra in 1916 and the two at 201 Greene Street, those of Pellagrins 1399 and 1400, fall into the second zone in this study. These are the only incident cases in Zone 2 in 1916, that is, the only new cases of pellagra originating in households previously free from this disease. It would seem that the condition of the privy of the house next door may have had more than accidental relation to these cases.

The population in Zone 2 for the entire community in 1916 numbered 1,006 persons, so that the incidence rate in this zone was 0.20 per cent. For the district adjacent to the mill village proper, the population in Zone 2 numbered 139, so that the two incident cases in this population give an indicated incidence rate of 1.44 per cent. In the mill village proper the population of Zone 2 numbered 867* persons. No incident cases of pellagra were found here.

*This number includes eight persons living in unsewered mill houses at 112 Farley Avenue and 264 Howard Street.

In Zone 3 the population of the entire community numbered 940 persons, of the adjacent district, 146 persons, and of the mill village proper, 794 * persons. No incident cases of pellagra could be found in this population in 1916.

COMMENT

In the foregoing pages we have attempted to present in detail the records of all the recognized incident cases of pellagra which have originated in Spartan Mills and the district adjacent, in so far as these records relate to location of domicile and to onset of the disease. The incidence rate of pellagra in each of the zones of exposure is shown for each year in Table 17 and is indicated graphically in Figure 13. In the data previous to 1914 there is shown a somewhat higher inci-

TABLE 17.—THE INCIDENCE OF PELLAGRA IN EACH ZONE IN EACH YEAR

Year	Zone 1			Zone 2			Zone 3		
	Instances of Exposure	Incident Pellagrins	Incidence%	Instances of Exposure	Incident Pellagrins	Incidence%	Instances of Exposure	Incident Pellagrins	Incidence%
1912	193	4	2.07	589	4	0.68	700	4	0.57
1913	427	15	3.51	1,176	12	1.02	925	6	0.65
1914	427	7	1.64	1,144	12	1.05	1,059	1	0.10
1915	439	5	1.14	1,174	5	0.43	1,069	0	0.00
1916	215	3	1.40	1,006	2	0.20	940	0	0.00
1912 and 1913	620	19	3.06	1,765	16	0.91	1,625	10	0.62
1914 to 1916, inclusive	1,081	15	1.39	3,324	19	0.57	3,059	1	0.03
1912 to 1916, inclusive	1,701	34	2.00	5,089	35	0.69	4,684	11	0.23

dence of pellagra in Zone 1 than in the other zones, but the records for these years indicate very little difference between the incidence in Zone 2 and that in Zone 3. However, in the records for 1914, 1915 and 1916 the zone relationship, to which we have previously called attention, is very distinct. The first census of this population was made in August and September, 1913, and, in our opinion, the incompleteness of the records previous to that time accounts, to a very large extent, for the number of pellagrins assigned to Zone 3. The figures for the last three years, on the other hand, are much more complete and they show very clearly the tendency for new cases of pellagra to appear almost exclusively in persons living in the same house with a pellagrin or next door to such a house.

* This number includes twenty-six persons living in unsewered mill houses at 503 Arch Street, 116 Farley Avenue, 122 Farley Avenue and 316 Howard Street.

From a study of these data one may get the impression that pellagra never appears in people who have not resided in the same house with or next door to a pellagrin within the previous six months. We certainly recognize, nevertheless, that pellagra may occasionally develop in persons, especially adults, who have been away from pellagra districts even for years. When one remembers the remarkable intervals which sometimes elapse between succeeding attacks of pellagra, discussed in a previous paper [2] of this series, it would be surprising if the apparent incubation period of the disease were not also very prolonged in some instances, especially in patients whose actual initial attack was so mild as to have passed unrecognized. The essential and important point in

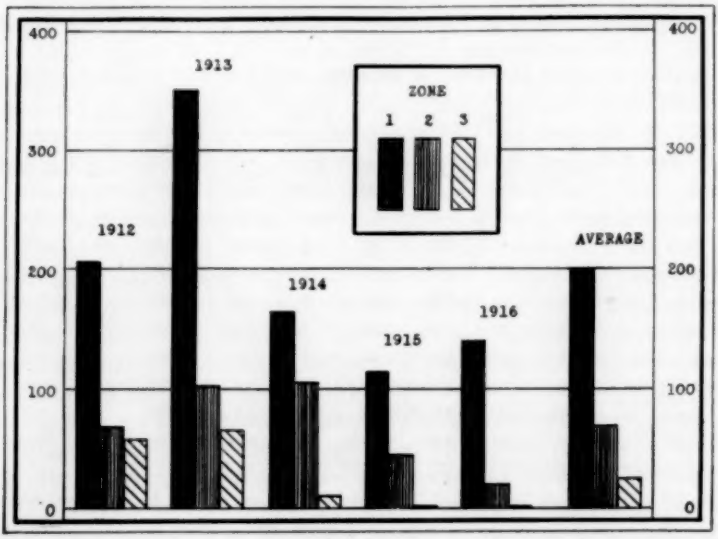

Fig. 13.—Incidence of pellagra per 10,000 population in each of the three domiciliary zones in Spartan Mills and the adjacent district from 1912 to 1916, inclusive. Note the almost complete absence of new cases of pellagra from Zone 3 since the beginning of accurate records at the end of 1913.

this study is that in the active endemic foci of pellagra, where many cases are originating, there the bulk of the new cases appear in persons who have resided very close to active antecedent cases of the disease within the preceding six months and, indeed, within the preceding three months in the warmer season of the year. As indicated in our Second

2. Siler, J. F., Garrison, P. E., and MacNeal, W. J.: The Subsequent History of Pellagrins in Spartanburg County, S. C., Who Survived the Initial Attack, THE ARCHIVES INT. MED., 1916, **18**, 340.

Progress Report, we regard this as important evidence that pellagra spreads from preëxisting pellagrins, and that it is ordinarily transmitted to new victims through only very short distances under the conditions obtaining in industrial communities such as this one. It will be noted that since Spartan Mills has been provided with a sewer system, pellagra has shown much less tendency to spread even to the house next door. In 1915 there would appear to be one clear-cut instance of such dissemination from 265 College Street, and in 1916 a similar instance of dissemination from 217 Greene Street. In both instances the relation to defective sanitation was obvious.

Certain criticisms of our previous domicile study have been offered. The actual existence of such a domiciliary relationship has been questioned. The only answer to this criticism we care to offer at present is the suggestion that an analogous complete census and equally complete domicile study be made in other foci of pellagra by those who are not yet convinced. The second criticism has been expressed by Vedder[3] in an another paper in this present series, constituting our third report. He admits that the zone relationship observed by us may actually exist, but assumes that the real explanation lies in the tendency for people in poor financial circumstances to live near each other in certain sections of these villages, wherein is segregated the population made up of pellagrins and others who consume deficient diets. This assumption would appear not wholly justified in the case of Spartan Mills, for the maps accompanying this paper show that pellagra has been fairly well distributed over the community. Furthermore, we have been unable to discover actual facts in regard to dietary which would support this assumption as far as this community is concerned, nor are we at all convinced that Vedder, in his own observation, was able to discover such facts. This investigator has also assumed that the higher incidence of pellagra in our Zone 1 is just what would be expected if the disease were due essentially to the dietary. A certain confusion of ideas seems to exist in this connection. Our observations do not indicate the frequent simultaneous development of pellagra in several members of a household previously free from the disease and, indeed, such cases have not been assigned to Zone 1. The usual course of events is exemplified by the appearance of one case of pellagra in the household, followed after several months, or even years, by the secondary cases. Such secondary cases have been classed in Zone 1. Vedder has apparently failed to perceive this distinction, or else he has overlooked its significance. Indeed, we have been able to observe, in some instances, that the appearance of one case of pellagra in a family has been followed by definite changes in the

3. Vedder, E. B.: Dietary Deficiency as the Etiological Factor in Pellagra, THE ARCHIVES INT. MED., 1916, **18**, 137.

family dietary, in spite of which subsequent cases of pellagra have appeared in the household in the following years. In this connection it is interesting to note, also, the not uncommon association in the same household of active and inactive cases of pellagra. Such associations may be seen on the map for 1913, Figure 9, at 135 Burnett Street, 128 Colton Street, 254 Howard Street and 115 Wolfe Street. On the map for 1914, Figure 10, similar associations may be seen at 135 Burnett Street, 317 College Street, 135 Choice Street, 111 Jennings Street and 137 Johnson Street. On the maps for 1915 and 1916 such associations are even more numerous. Assuming, as Vedder has, that the members of the household consume the same diet and that the deficiency in this diet may be the cause of pellagra and explain its zone distribution, it is, at least, somewhat curious that one member of the family recovers and in another member the disease recurs while still another member has an initial attack of the disease at the same time, and that such associations of active and inactive pellagrins in the same household are so frequently observed.

In addition to presenting a study of the relation of incident pellagra to domicile, this paper offers also detailed records in regard to the influence on the pellagra situation of the installation of sewers at Spartan Mills, which we have discussed more briefly in the immediately preceding paper of this series. Vedder, in his paper, refers to the installation of sewers at Spartan Mills and suggests that the adherents of the infection theory will be furnished their answers by this experiment. He says, "The diet has remained unchanged so far as known." Further on he says, "It would perhaps be unfair to point to the amount of pellagra in Spartan Mills this year as an evidence of the failure of this sewer system to prevent the disease, since the system has only been in full operation since May of this year." This last statement refers, of course, to 1914. A careful scrutiny of the new cases of pellagra in 1914, with due attention to their residences and the time of onset of the disease, shows at least a suggestive relation to the date of sewer installation in 1913 or 1914. This relationship has become more distinct in the subsequent years, as will be seen by reference to the maps. The total number of incident cases, including the doubtful cases and the total number of other active pellagrins residing in Spartan Mills and in the adjacent surveyed district in each year are shown in Table 18, and the data are presented graphically in Figure 14. It seems to us that the change in pellagra incidence has been rather striking, so definite, in fact, that the supporters of the theory of dietary deficiency might be willing now to assume that a change in diet had taken place. Any such assumption would, obviously, at once lead to a dilemna, because of the large number of nonincident active cases of pellagra present in 1914, 1915 and even in 1916, for whom a poor diet would require to be

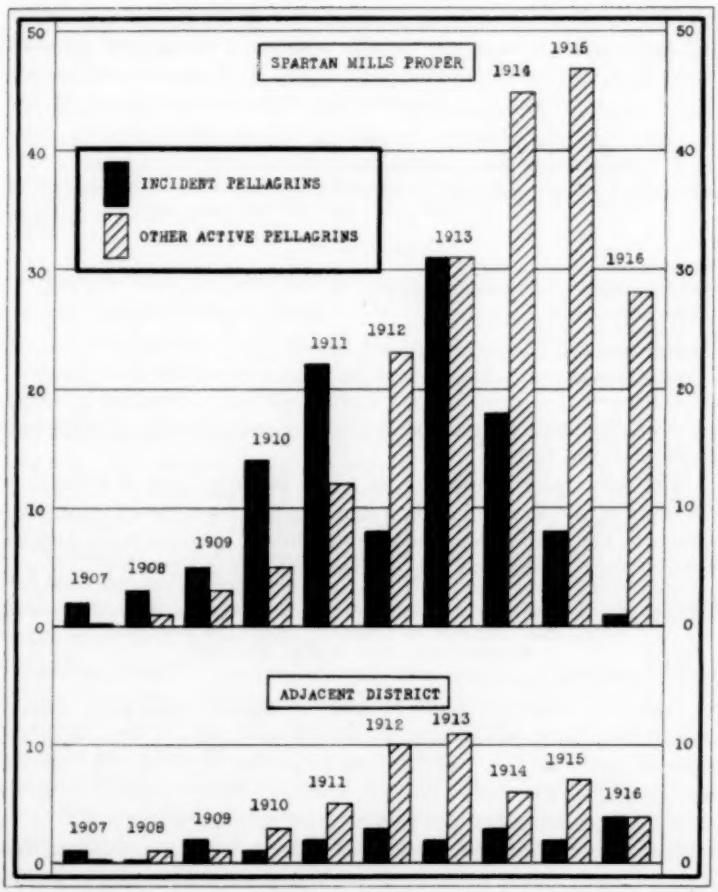

Fig. 14.—The actual number of pellagrins incident in each year and the number of other active pellagrins present in each year in Spartan Mills and the district adjacent to it. The water-carriage system of sewers was installed in Spartan Mills proper, between August, 1913, and May, 1914. Note the very considerable reduction in the number of incident pellagrins in the subsequent years and the absence of a corresponding diminution in the number of other active pellagrins.

assumed. When, in addition, it is recalled that Vedder's observations in the fall of 1914 indicated that the diet had remained unchanged so far as known and that our own observations in 1914, 1915 and 1916 have shown no essential change in the dietary of the general population, but, on the other hand, a very definite addition to the food of the older nonincident cases of the disease in 1915 and 1916, the assumption of a dietary improvement as the cause of the diminished incidence of pellagra would appear not only useless for the argument, but also opposed to the observed facts.

TABLE 18.—Incident Cases of Pellagra and Other Active Cases of Pellagra in Spartan Mills in Each Year to Aug. 1, 1916

	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
Spartan Mills										
Incident cases	2	3	5	14	22	8	31	18	8	1
Other active cases	0	1	3	5	12	23	31	45	47	28
Adjacent District										
Incident cases	1	0	2	1	2	3	2	3	2	4
Other active cases	0	1	1	3	5	10	11	6	7	4

The domiciliary relationship of newly incident cases of pellagra to old cases of the disease in this community has been found to be quite similar to the relationship demonstrated in our previous study and we are still very strongly of the opinion that this relationship indicates unmistakably the infectious nature of pellagra, as well as the fact that it spreads only slowly and only through very short distances, as a rule. It is, furthermore, evident that it spreads to only a small part of the exposed population and that the males in the age period from fifteen to forty-five years * are not often susceptible. Of the 133 persons who

TABLE 19.—Distribution According to Sex and Age, of the 133 Cases of Pellagra Incident in Spartan Mills and Adjacent District from 1907 to 1916, Inclusive

Age	0-14	15-29	30-44	Over 45	Age Unknown	Total
Females	22	55	22	12	2	103
Males	17	1	4	8	0	30

* The relative insusceptibility to pellagra of young adult men is generally recognized. If one should desire, therefore, to obtain positive results in experimental inoculations of man, it would obviously be wise to select the experimental subjects from some other group of the population, children from 2 to 10 years of age and childbearing women from 20 to 45 being most valuable for this purpose. The recently published negative experiment carried out by the United States Public Health Service (Goldberger, Joseph: The Trans-

contracted pellagra in Spartan Mills and the district adjacent to it during the ten years 1907 to 1916, inclusive, only five were men in the age period 15 to 45, as will be seen in Table 19. The ages of four of these men were 41, 44, 28 and 36, respectively, and the fifth was a man between 40 and 50. All were factory laborers and one of them is known to have been a chronic alcoholic.

In its tendency to attack only a small part of the exposed population, pellagra would appear to resemble more nearly such relatively noncontagious diseases as leprosy, tuberculosis and typhoid fever, rather than the more actively contagious disorders, such as small-pox, measles or diphtheria.

SUMMARY

1. Spartan Mills is a fairly typical cotton-mill village in which pellagra has long been endemic.

2. The incomplete data for the years previous to 1914 do not permit one to decide whether location of domicile was correlated with incidence of pellagra at that time.

3. Since 1914 nearly all newly incident cases of pellagra in this community developed while the persons were residing in the same house with or next door to a pellagrin in the active stage of the disease, or within six months after the termination of such exposure.

4. Since the installation of the sewer system, the spread of pellagra has been decidedly restricted. In 1916 the only considerable focus of new cases was in the immediate neighborhood of a dilapidated outhouse privy used by pellagrins.

5. The present more detailed study of more complete data in regard to this community shows the relation of domicile to pellagra here to be essentially similar to the relation shown by the other five villages reported on in our Second Progress Report. At the time of that report, the apparent relationship in this one village was exceptional.

6. These studies support our previous conclusion that pellagra is an infectious disease, which spreads slowly, attacking only a small proportion of the population residing in the immediate vicinity, and they indicate, further, that its spread is especially favored by insanitary methods for the disposal of human wastes.

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missibility of Pellagra, Pub. Health Rep., 1916, **31**, 3159) would appear, therefore, to have little or no bearing on the question of the transmissibility of pellagra, although it may be of some value in confirming the previously well known fact that healthy men in the more active period of life are quite refractory to the disease.

TABLE 20.—Domicile Relationship—Spartan Mills—1912

1912	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Allen												
115	...	....	No data for 1912									
117	...	....	.....	..	..	445	Entire 1912.....	3	0			
118	445	1907	Entire 1912.....	3	0							
124	...	....	.....	..	..	445, 16, 505, 506	Entire 1912.....	2	0			
127	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
128	16	1908	Early 1912 to end 1912...	9	0							
	505	1912	Oct. to end 1912									
	506	1912										
130	...	....	.....	..	..	505, 506, 16	Entire 1912.....	4	0			
131	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
137	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
141	...	....	No data for 1912									
145	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
148,	...	....	.....	..	..	16, 505, 506	Entire 1912.....	6	0			
149	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
Arch												
371	64	1910	To March, 1912. (No other members of family. No further data for 1912)									
	65	1910										
379	...	....	.....	..	..	225, 64, 65	Entire 1912.....	8	0			
385	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	9	0
393	...	....	.....	..	..	105	To Spring, 1912.....	7	0	Spring to end 1912.....	7	0
397	105	1911	To Spring, 1912. (No other members of family. No further data for 1912)									
403	...	....	.....	..	..	105	To Spring, 1912.....	9	0	Spring to end 1912.....	9	0
409	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	12	0
508	...	....	No data for 1912									
Brawley												
190	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
191	...	....	.....	..	..	.....	.....	..	..	Dec. to end 1912..... (No data to Dec.)	5	0
194	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	9	0
195	...	....	No data for 1912									
196	...	....	No data for 1912									
197	202	1912	Aug. 1 to Aug. 28, 1912 (Moved Aug. 28)	5	0	.....	.....	..	..	To Aug. 1, 1912.....	6	1
										Aug. 28 to end 1912.... (New family Aug. 28)	7	0
201	...	....	.....	..	..	.....	.....	..	..	Sept. to end 1912..... (No data to Sept.)	7	0
202	...	....	.....	..	..	202	Aug. 1 to Aug. 28, 1912	5	0	To Aug., 1912..... Aug. 28 to end 1912	5	0
204	...	....	.....	..	..	202	Aug. 1 to Aug. 28, 1912	6	0	To Aug., 1912..... Aug. 28 to end 1912	6	0
205	...	....	No data for 1912									
218	...	....	.....	..	..	202	Aug. 1 to Aug. 28, 1912	2	0	To Aug., 1912..... Aug. 28 to end 1912	2	0
219	...	....	.....	..	..	.....	.....	..	..	Sept. to end 1912..... (No data to Sept.)	3	0
224	...	....	.....	..	..	445	Entire 1912.....	6	0			

225	...	....	.....	..	..	.....	.....	..	..	Aug. to end 1912..... (No data to Aug.)	4	0
230	...	....	.....	..	..	445	Entire 1912.....	3	0			
231	...	....	No data for 1912									
234	...	....	.....	..	..	16, 505, 506	Entire 1912.....	3	0			
235	...	....	.....	..	..	236	Aug. to end 1912.....	6	0	To Aug., 1912.....	6	0
248	...	....	.....	..	..	16, 506, 506	Entire 1912.....	5	0			
256	...	....	No data for 1912									
272	...	....	.....	..	..	236	Aug. to end 1912.....	5	0	To Aug., 1912.....	5	0
280	...	....	No data for 1912									
288	...	....	No data for 1912									
296	236	1911	To Aug., 1912. (Moved Aug. No further data data for 1912)	5	0							
302	...	....	No data for 1912									
303	...	....	.....	..	..	236	To Aug., 1912.....	5	0	Aug. to end 1912.....	5	0
306	...	....	No data for 1912									
309	...	....	.....	..	..	.....	.....	..	..	Dec. to end 1912..... (No data to Dec.)	4	0
312	...	....	.....	..	..	1171, 1172, 1173	Sept. 1 to end 1912.... (No data to Sept.)	2	0			
316	...	....	.....	..	..	1171, 1172, 1173	Aug. to end 1912..... (No data to Aug.)	3	0			
324	...	....	No data for 1912									
334	...	....	.....	..	..	1171, 1172, 1173	Entire 1912.....	9	0			
339	...	....	.....	..	..	1171, 1172, 1173	Entire 1912.....	2	0			
342	...	....	.....	..	..	68	Fall to end 1912.....	5	0	To Fall, 1912.....	5	0
350	...	....	.....	..	..	68, 69	Entire 1912.....	6	0			
360	...	....	No data for 1912									
384	...	....	No data for 1912									
389	...	....	Vacant house									
390	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
396	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
402	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
Burnett												
109	...	....	.....	..	..	.....	.....	..	..	Sept. to end 1912..... (No data to Sept.)	9	0
110	...	....	No data for 1912									
117	...	....	No data for 1912									
118	...	....	.....	..	..	1290, 1291, 1292	Fall to end 1912..... (No data to Fall)	4	0			
127	1290	1912	Spring to end 1912.....	2	1	64, 65	Mar. 1 to Spring, 1912	4	2	To Mar. 1, 1912.....	4	0
	1291	1912										
	1292	1912	Summer to end 1912									
128	...	....	No data for 1912									
134	...	....	No data for 1912									
135	64	1910	Mar. 1 to end 1912.....	2	0							
	65	1910	(No data to March)									
	63	1912	July to Nov., 1912									
144	...	....	No data for 1912									
145	...	....	No data for 1912									
152	...	....	.....	..	..	.....	.....	..	..	Apr. to end 1912..... (No data to Apr.)	2	0
153	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
160	...	....	.....	..	..	443	Aug. to end 1912..... (No data to Aug.)	3	0			
161	...	....	No data for 1912									
167	...	....	No data for 1912									
168	...	....	No data for 1912									

TABLE 20.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1912—(*Continued*)

1912	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
174	...	....	.....	..	..	443	Aug. to end 1912..... (No data to Aug.)	6	0			
175	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
181	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
182	...	....	No data for 1912									
Choie-												
111	...	....	.....	..	..	206	Entire 1912.....	4	0			
119	206	1911	Entire 1912.....	4	0							
127	...	....	.....	..	..	203, 204, 515, 206	Entire 1912.....	3	0			
135	...	....	No data for 1912									
224	...	....	See 134-142 Montgomery St.									
College												
151-155	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
163-167	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	14	0
178	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
175-179	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
186	...	....	No data for 1912									
191	...	....	No data for 1912									
194	105	1911	Spring to end 1912..... (No data to Spring)	18	0							
254	...	...	.....	..	..	.....	.....	..	..	Oct. to end 1912..... (No data to Oct.)	4	0
260	..	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
264	...	....	.....	..	..	238	Entire 1912.....	7	0			
265	...	....	No data for 1912									
271	...	...	.....	..	..	.....	.....	..	..	Aug. to end 1912..... (No data to Aug.)	7	0
272	..	....	.....	..	..	238	Oct. to end 1912..... (No data to Oct.)	7	0			
277	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
278	..	....	.....	..	..	203, 204	To Feb., 1912.....	4	0	Feb. to end 1912.....	4	0
282	...	....	No data for 1912									
283	...	....	No data for 1912									
291	...	....	See 288 Brawley									
294	...	....	See 296 Brawley									
297	...	....	.....	..	..	236	To Aug., 1912.....	5	0	Aug. to end 1912.....	5	0
298	...	....	.....	..	..	236	To Aug., 1912.....	2	0	Aug. to end 1912.....	2	0
303	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
304	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
310	...	....	No data for 1912									
311	..	....	.....	..	..	197	June to end 1912.....	5	0	To June, 1912.....	5	0
317	197	1912	June to end 1912.....	17	0	.....	.....	..	..	To June, 1912.....	14	1
325	...	....	.....	..	..	197	June to Aug., 1912.... (Moved Aug. No further data for 1912)	5	1	Mar. to June, 1912.... (No data to Mar.)	5	0
331	...	....	.....	..	..	.....	.....	..	..	June to end 1912..... (No data to June)	5	0
334	...	....	.....	..	..	194, 70	Mar. to end 1912..... (No data to Mar.)	3	0			

337	...	....	.....	..	..	328, 198	Entire 1912.....	4	0			
338	...	....	No data for 1912									
343	198	1911	Entire 1912.....	4	0							
	328	1912	Nov. to end 1912 (Family of Case 328 not counted here for 1912)									
344	...	....	.....	..	..	328, 198, 625, 626	Entire 1912.....	6	0			
347	...	....	No data for 1912									
348	625	1911	Nov. to end 1912									
	626	1911	(No data to Nov. Family not counted here for 1912)									
Colton												
100	...	....	No data for 1912									
110	...	....	.....	..	..	.....	.....	..	..	To Apr., 1912..... (No further data)	2	0
116	444*	1907	.....	..	..	1313	Fall to end 1912.....	6	0	To Fall, 1912.....	6	0
119	1313	1912	Fall to end 1912 (No data to Fall. Family counted at 120 Wolfe for 1912)									
122	...	....	.....	..	..	1313, 237	Entire 1912.....	4	0			
127	...	....	.....	..	..	1313, 33, 237	Entire 1912.....	2	0			
128	...	....	No data for 1912									
131	227	1909	Entire 1912.....	3	0							
134	...	....	.....	..	..	237	Apr. to end 1912..... (No data to Apr.)	2	0			
135	...	....	No data for 1912									
138	...	....	.....	..	..	443	June to end 1912.....	5	0	To June, 1912.....	5	0
142	443	1912	June to end 1912.....	6	0					To June, 1912.....	7	1
148	...	....	.....	..	..	443	June to end 1912.....	9	0	To June, 1912.....	8	0
156	...	....	No data for 1912									
Dickson												
116	...	....	No data for 1912									
118	...	....	.....	..	..	.....	.....	..	..	Nov. to end 1912..... (No data to Nov.)	3	0
120	...	....	No data for 1912									
126	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
128	...	....	.....	..	..	203, 204	Entire 1912.....	3	0			
130	203	1911	Feb. to end 1912.....	2	0							
	204	1911	(No data to Feb.)									
132	515	1910	Entire 1912.....	8	0							
134	...	....	.....	..	..	515, 206	Entire 1912.....	5	0			
Duncan												
103	232	1911	Entire 1912.....	3	0							
104	...	....	.....	..	..	232	Entire 1912.....	6	0			
113	...	....	No data for 1912									
114	...	....	.....	..	..	232	Oct. to end 1912..... (No data to Oct.)	6	0			
121	...	....	No data for 1912									
122	...	....	.....	..	..	105	To Spring, 1912.....	6	0	Spring to end 1912.....	6	0
129	...	....	.....	..	..	.....	.....	..	..	To Apr., 1912..... (No further data for 1912)	5	0
130	...	....	No data for 1912									
137	...	....	No data for 1912									
138	...	....	No data for 1912									

* Pellagrins designated in this manner are not considered active centers of the disease in this year.

TABLE 20.—Domicile Relationship—Spartan Mills—1912—(*Continued*)

1912	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
145	...	....	No data for 1912									
146	...	....	.....	..	..	235	Nov. to end 1912..... (No data to Nov.)	7	0			
153	...	....	No data for 1912									
154	225	1911	Entire 1912.....	6	0							
Farley												
112	...	....	.....	..	..	436, 437	Oct. to end 1912.....	2	0	To Oct., 1912.....	2	0
116	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
122	...	....	.....	..	..	113, 115	Entire 1912.....	2	0			
133	115	1909	Entire 1912.....	4	0							
	113	1912	Sept. to end 1912									
141	503	1911	Oct. to Nov. 29, 1912.... (Family of Case 503 counted at 118 Manning for 1912)	6	1	113, 115, 503	To Oct., 1912.....	6	0			
147	...	....	No data for 1912									
148	...	....	.....	..	..	503	Oct. to end 1912.....	8	0	To Oct., 1912.....	8	0
153	...	....	.....	..	..	503	Entire 1912.....	3	0			
154	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	8	0
159	...	....	No data for 1912									
160	...	....	No data for 1912									
166	808	1912	Summer to end 1912.....	7	0	.....	.....	..	..	To Summer, 1912.....	8	1
171	...	....	No data for 1912									
172	...	....	No data for 1912									
177	...	....	No data for 1912									
178	...	....	No data for 1912									
189	...	....	See 300 Brawley									
190	...	....	.....	..	..	68, 69	Entire 1912.....	4	0			
208	...	....	.....	..	..	68, 69, 232	Entire 1912.....	7	0			
213	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
214	...	....	.....	..	..	232	Entire 1912.....	6	0			
221	...	....	.....	..	..	750	Aug. to end 1912.....	5	0	To Aug., 1912.....	5	0
222	...	....	.....	..	..	750	Aug. to end 1912.....	7	0	To Aug., 1912.....	7	0
229	750	1910	Aug. to end 1912..... (No data to Aug.)	1	0							
230	...	....	No data for 1912									
237	...	....	.....	..	..	748, 750, 574	Entire 1912.....	6	0			
238	...	....	No data for 1912									
245	...	....	No data for 1912									
246	574	1911	Entire 1912.....	3	0							
253	...	....	No data for 1912									
254	...	....	.....	..	..	574	Sept. to end 1912..... (No data to Sept.)	7	0			
Forest												
272	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
276	...	....	No data for 1912									
304	...	....	No data for 1912									
305	...	....	.....	..	..	197	June to end 1912.....	12	0	To June, 1912.....	12	0

316	...	....	See 325 College										
317	...	....	See 317 College										
327	...	....	No data for 1912										
328	...	....	Hospital										
331	...	....	.....	..	..	70, 194	Entire 1912.....	9	0				
334	70	1905	Entire 1912.....	3	0								
	194	1910											
335	...	....	.....	..	..	70, 194, 195	Entire 1912.....	4	0				
338	195	1911	Entire 1912.....	4	0								
339	...	....	.....	..	..	70, 194, 195	Entire 1912.....	4	0				
343	...	....	.....	..	..	195	Entire 1912.....	5	0				
344	...	....	.....	..	..	195	Entire 1912.....	3	0				
349	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0	
352	...	....	.....	..	..	68	Fall to end 1912.....	6	0	To Fall, 1912.....	6	0	
353	...	....	.....	..	..	68	Fall to end 1912.....	4	0	To Fall, 1912.....	4	0	
356	...	....	.....	..	..	68, 69	Entire 1912.....	6	0				
357	68	1911	Fall to end 1912 (No data to Fall. Family counted at 363 Forest)										
362	...	....	.....	..	..	68, 69	Entire 1912.....	5	0				
363	69	1910	Entire 1912.....	11	0								
	68	1911	To Fall, 1912										
431	...	....	.....	..	..	232	Entire 1912.....	6	0				
435	...	....	No data for 1912										
439	...	....	No data for 1912										
443	...	....	No data for 1912										
Greene													
102	...	....	No data for 1912										
103	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0	
110	...	....	No data for 1912										
111	...	....	.....	..	..	236	Aug. to end 1912.....	5	0	To Aug., 1912.....	5	0	
118	...	....	.....	..	..	236	Aug. to end 1912.....	10	0	To Aug., 1912.....	10	0	
119	236	1911	Aug. to end 1912 (Family counted at 296 Brawley for 1912)										
136	...	....	See 272 Brawley										
146	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0	
154	...	....	No data for 1912										
162	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0	
172	...	....	No data for 1912										
181	...	....	No data for 1912										
184	...	....	See 306 Forest										
196	...	....	See 304 Forest										
201	...	....	No data for 1912										
206	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0	
216	...	....	No data for 1912										
217	...	....	No data for 1912										
226	...	....	.....	..	..	198, 328	Entire 1912.....	4	0				
Howard													
187	...	....	.....	..	..	105	Spring to end 1912....	2	0	To Spring, 1912.....	2	0	
193	...	....	.....	..	..	105	Spring to end 1912....	7	0	To Spring, 1912.....	3	0	
199	...	....	No data for 1912										
204	...	....	.....	..	..	1419	Aug. to end 1912.....	5	0	To Aug., 1912.....	5	0	
205	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0	
212	1419	1912	Aug. to end 1912..... (No data to Aug.)	4	0								
218	...	....	.....	..	..	1419	Aug. to end 1912.....	5	0	To Aug., 1912.....	5	0	

TABLE 20.—Domicile Relationship—Spartan Mills—1912—(*Continued*)

1912	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
222	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
230	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	11	0
236	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
254	435	1910	Oct. to end 1912.....	5	0							
	436	1910	(No data to Oct.)									
	437	1910										
264	...	....	.....	..	..	436, 437	Oct. to end 1912.....	4	0	To Oct., 1912.....	4	0
316	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	12	0
Jennings												
110	...	....	.....	..	..	207	Entire 1912.....	2	0			
111	207	1907	Entire 1912.....	3	0	.....	.....	..	..			
118	...	....	.....	..	..	207, 1290, 1291, 1292	Entire 1912.....	2	0			
119	...	....	No data for 1912									
126	...	....	.....	..	..	1290, 63, 1291, 64, 1292, 65	Entire 1912.....	3	0			
127	...	....	No data for 1912									
134	...	....	No data for 1912									
135	...	....	No data for 1912									
142	...	....	No data for 1912									
143	...	....	No data for 1912									
150	...	....	No data for 1912									
151	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
158	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
159	...	....	No data for 1912									
166	...	....	No data for 1912									
167	...	....	.....	..	..	508	Mar. to May, 1912.....	5	0	To Mar., 1912..... May to end 1912	5	0
174	...	....	.....	..	..	508	Mar. to May, 1912.....	3	0	To Mar., 1912..... May to end 1912	3	0
175	508	1911	Mar. to May, 1912.....	5	0	.....	.....	..	..	To Mar., 1912..... May to end 1912	4	0
181	...	....	No data for 1912									
182	...	....	.....	..	..	508	Mar. to May, 1912.....	5	0	To Mar., 1912..... May to end 1912	5	0
Johnson												
111	...	....	.....	..	..	11	To Sept., 1912.....	5	0	Sept. to end 1912.....	5	0
112	...	....	.....	..	..	11	Aug. to Sept., 1912.... (No data to Aug.)	5	0	Sept. to end 1912.....	5	0
116	11	1910	To Sept., 1912..... (Moved Sept.)	4	0	.....	.....	..	..	Sept. to end 1912.....	2	0
117	...	....	.....	..	..	11	To Sept., 1912.....	3	0	Sept. to end 1912.....	4	0
122	...	....	.....	..	..	11	To Sept., 1912.....	3	0	Sept. to end 1912.....	3	0
123	...	....	.....	..	..	11	To Sept., 1912.....	5	0	Sept. to end 1912.....	10	0
127	...	....	.....	..	..	116, 105	Entire 1912.....	7	0			
128	...	....	No data for 1912									
134	...	....	.....	..	..	116	Entire 1912.....	2	0			
137	116	1909	Entire 1912.....	2	0							

140	...	....	.....	..	..	116	To Apr., 1912..... (No further data for 1912)	2	0			
141	...	....	.....	..	..	116, 105	Entire 1912.....	6	0			
146	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
147	...	....	No data for 1912									
178	...	....	No data for 1912									
Langford												
1	...	....	No data for 1912									
2	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
3	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	2	0
4	...	....	No data for 1912									
5	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	2	0
Laurens												
158	...	....	No data for 1912									
159	...	....	.....	..	..	443	Nov. to end 1912..... (No data to Nov.)	7	0			
Manning												
110	...	....	.....	..	..	503, 238, 113, 115	Entire 1912.....	3	0			
111	...	....	.....	..	..	503, 238	Entire 1912.....	4	0			
118	503	1911	To July, 1912..... (No further data for 1912)	5	0							
119	238	1911	Entire 1912.....	8	0							
127	203	1911	To Feb., 1912.....	..	..	503, 238	Mar. to end 1912.....	3	0			
	204	1911	(Moved Feb. Counted at 130 Dickson)				(New family Mar.)					
134	...	....	.....	..	..	203, 204, 503, 238	Entire 1912.....	6	0			
135	...	....	.....	..	..	203, 204, 1171, 1172, 1173	Entire 1912.....	4	0			
142	...	....	.....	..	..	203, 204, 1171, 1172, 1173	Entire 1912.....	3	0			
143	...	....	.....	..	..	1171, 1172, 1173	Entire 1912.....	8	0			
150	1171	1911	Entire 1912.....	4	0							
	1172	1911										
	1173	1911										
Milan												
108	...	....	.....	..	..	519	Feb. to end 1912.....	8	0	To Feb., 1912.....	8	0
109	...	....	.....	..	..	519	Feb. to end 1912.....	4	0	To Feb., 1912.....	4	0
116	519	1911	Feb. to end 1912..... (No data to Feb.)	4	0							
117	...	....	.....	..	..	11, 519	Entire 1912.....	8	0			
123	...	....	.....	..	..	11, 519	Entire 1912.....	4	0			
124	...	....	.....	..	..	519	Feb. to end 1912.....	6	0	To Feb., 1912.....	6	0
128	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
129	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
134	...	....	No data for 1912									
135	...	....	No data for 1912									
140	...	....	No data for 1912									
141	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
147	654	1910				.....	.....	..	..	Entire 1912.....	5	0
148	...	....	No data for 1912									
152	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0

TABLE 20.—Domicile Relationship—Spartan Mills—1912—(*Continued*)

1912	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
155	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	2	0
158	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	4	0
159	...	....	.....	..	..	.....	.....	..	..	Aug. to end 1912..... (No data to Aug.)	7	0
165	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
Montgomery												
134, 138, 142	...	....	.....	..	..	.....	.....	..	..	Entire 1912..... (Tenement house)	17	0
280	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	5	0
Oliver												
113	749	1910	.....	..	..	196	Entire 1912.....	7	0			
114	...	....	.....	..	..	70, 194, 195	Entire 1912.....	2	0			
119	...	....	.....	..	..	750	Aug. to end 1912.....	2	0	To Aug., 1912.....	2	0
120	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	3	0
127	...	....	.....	..	..	750	Aug. to end 1912.....	8	0	To Aug., 1912.....	8	0
128	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	6	0
135	...	....	.....	..	..	748, 750	Entire 1912.....	4	0			
136	...	....	.....	..	..	748, 625, 626	Entire 1912.....	3	0			
141	748	1911	Entire 1912.....	4	0	.....	.....	..	..			
142	...	....	.....	..	..	748, 625, 626	Entire 1912.....	6	0			
Vaughn												
1	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	8	0
2	...	....	No data for 1912									
3	...	....	.....	..	..	.....	.....	..	..	Entire 1912.....	7	0
Wolfe												
111	...	....	No data for 1912									
112	...	....	.....	..	..	33, 25, 26, 27, 1313	Entire 1912.....	5	0			
114	33	1910	June to end 1912..... (No data to June)	4	0							
115	25	1910	Entire 1912.....	4	2							
	26	1912	June to end 1912									
	27	1912										
120	1313	1912	Spring to Fall, 1912..... (Moved fall)	1	0	237, 25	To Spring, 1912.....	2	1			
121	...	....	.....	..	..	25, 26, 27, 33, 1312	Entire 1912.....	5	0			
122	...	....	.....	..	..	1313	Spring to Fall, 1912... (No further data for 1912)	5	0			

TABLE 21.—Domicile Relationship—Spartan Mills—1913

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Allen												
115	...	....	No data for 1913									
117	...	....	.....	..	..	445, 46, 60, 61, 740	To Dec., 1913.....	4	0	Dec. to end 1913.....	4	0
118	445	1907	To Oct., 1913..... (Moved Oct.)	3	0	.....	.....	..	..			
	46	1912	Oct. to Dec., 1913									
	60	1912	(New family Oct.;									
	61	1912	counted at 217									
	860*	1910	Greene)									
124	...	....	.....	..	..	445, 46, 60, 61, 740, 16, 505, 506	To Dec., 1913.....	2	0	Dec. to end 1913.....	2	0
127	740	1913	Feb. to Oct., 1913..... (Moved Oct.; no further data)	2	0	.....	.....	..	..	To Feb., 1913.....	2	1
128	16	1908	To Aug., 1913..... (Moved Aug.)	9	0	445, 46, 60, 61	Sept. to end 1913..... (New family Sept.)	3	0			
	505	1912	To Mar., 1913									
	506	1912	(Moved Mar.)									
130	...	....	.....	..	..	16, 505, 506	To Aug., 1913.....	4	0	Aug. to end 1913.....	4	0
131	...	....	.....	..	..	740	Feb. to Oct., 1913.....	7	0	To Feb., 1913.....	7	0
										Oct. to end 1913		
137	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	3	0
141	445	1907	Nov. to end 1913 (No data to Nov.; family counted at 118 Allen for 1913)									
145	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
148	...	....	.....	..	..	16, 505, 506, 445	Entire 1913.....	10	0			
149	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0
Arch												
371	1421	1913	Sept. to end 1913..... (No data to Sept.)	5	0							
379	...	....	.....	..	..	235, 1421	Entire 1913.....	8	0			
385	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	9	0
393	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
397	...	....	.....	..	..	.....	.....	..	..	July to end 1913..... (No data to July)	5	0
403	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	9	0
409	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	12	0
503	...	....	No data for 1913									
Brawley												
190	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
191	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
194	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	10	0
195	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	3	0
196	...	....	No data for 1913									
197	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
201	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0
202	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0

* Pellagrins designated in this manner are not considered active centers of the disease in this year.

TABLE 21—Domicile Relationship—Spartan Mills—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
204	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
205	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1913..... (No data to Mar.)	6	0
218	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	2	0
219	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	3	0
224	...	....	.....	..	..	445, 46, 60, 61	To Dec., 1913.....	6	0	Dec. to end 1913.....	6	0
225	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
250	...	....	.....	.	..	445, 46, 60, 61	To Dec., 1913.....	3	0	Dec. to end 1913.....	3	0
231	...	....	.....	..	..	.....	.....	..	..	Apr. to end 1913..... (No data to Apr.)	4	0
234	...	....	.....	..	..	445, 16, 505, 506	Entire 1913.....	3	0			
235	...	....	.....	..	..	236, 920	To June, 1913..... Sept. to Nov., 1913	6	0	June to Sept., 1913..... Nov. to end 1913	6	0
248	...	....	.....	..	..	16, 445, 505, 506	Entire 1913.....	5	0			
256	...	....	.....	..	..	445	Nov. to end 1913.....	4	0	June to Nov., 1913..... (No data to June)	4	0
272	...	....	.....	..	..	236, 1134	To Aug., 1913.....	6	0	Aug. to end 1913.....	7	0
280	...	....	Vacant house									
288	...	....	.....	..	..	.....	.....	..	..	Apr. to end 1913..... (No data to Apr.)	6	0
296	...	....	.....	..	....	.....	.....	..	..	May to end 1913..... (No data to May)	15	0
302	...	....	.....	..	..	.....	.....	..	..	June to end 1913..... (No data to June)	6	0
303	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
306	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1913..... (No data to Mar.)	7	0
309	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
312	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
316	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
324	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0
334	...	....	.....	..	..	1016	June to July, 1913.....	9	0	To June, 1913..... July to end 1913	9	0
339	...	....	.....	..	..	228, 1016	Entire 1913.....	6	0			
342	1016	1913	June 15 to July, 1913.... (Moved July)	10	0	66, 238	To June 15, 1913..... July to end 1913 (New family)	5 2	0 0			
350	...	....	.....	..	..	68, 69, 238, 1016	Entire 1913.....	6	0			
360	...	....	.....	..	..	68, 69, 228	May to end 1913..... (No data to May)	10	0			
384	...	.....	No data for 1913									
389	...	...	Vacant house									
390	...	....	.....	..	..	222	Entire 1913.....	8	0			
396	...	....	.....	..	..	232	Entire 1913.....	4	0			
402	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
Burnett												
109	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	12	0
110	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0

117	...	....	.....	..	..	.....	.....	..	..	Oct. to end 1913..... (No data to Oct.)	4	0
118	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
127	...	....	.....	..	..	295, 64, 65	Entire 1913.....	5	0			
128	...	....	No data for 1913									
134	...	....	Family counted at 149 Allen for 1913									
135	64	1910	Entire 1913.....	2	1							
	65	1910										
	295	1913	May to Aug., 1913									
144	...	....	No data for 1913									
145	1337	1913	Spring to end 1913.....	5	0	64, 65	Feb. to Spring, 1913... (No data to Feb.)	6	1			
152	...	....	.....	..	..	1290, 742, 1291, 703, 1292, 736, 1337	Mar. to end 1913..... (No data to Mar.)	3	0			
153	..	....	.....	..	..	1337, 736, 703	Entire 1913.....	7	0			
160	...	....	.....	..	..	742, 736, 703, 443	Entire 1913.....	3	0			
161	703	1912	Entire 1913.....	7	1							
	736	1913	July to end 1913									
167	...	....	.....	..	..	736, 703, 1312	July to end 1913..... (No data to July)	9	0			
168	...	....	No data for 1913									
174	...	....	.....	..	..	443, 868, 508, 1376, 1312	Entire 1913.....	6	0			
175	1312	1913	Summer to end 1913.....	2	0	529, 508, 530, 1228	To Summer, 1913.....	3	1			
181	508	1911	To death, May, 1913....	6	0	529, 530, 1228, 1312	May to end 1913.....	6	0			
182	...	....	.....	..	..	508, 868, 1312, 1376	Feb. to end 1913..... (No data to Feb.)	8	0			
Cholce												
111	...	....	.....	..	..	206, 718	Entire 1913.....	4	0			
119	206	1911	Entire 1913.....	4	0							
127	...	....	.....	..	..	206, 515, 203, 204, 651, 652, 653, 654, 194	Entire 1913.....	3	0			
135	651	1913	Dec. to end 1913.....	..	..	203, 204, 515, 194	To Fall, 1913..... (Moved Fall)	6	0			
	652	1913	(New family; count-									
	653	1913	ed at 147 Milan									
	654	1910	for 1913)									
224	...	....	See 134-142 Montgomery									
College												
151-155	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
163-167	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	14	0
178	...	....	.....	..	..	434	Mar. to July, 1913.....	3	0	To Mar., 1913.....	3	0
										July to end 1913		
175-179	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
186	...	....	.....	..	..	105, 116, 552, 434	Entire 1913.....	9	0			
191	...	....	.....	..	..	105	To Sept., 1913.....	7	0	Sept. to end 1913.....	7	0
194	105	1911	To Sept., 1913.....	20	0	116, 552, 560	Sept. to end 1913.....	12	0			
254	796	1913	May to July, 1913..... (Moved July)	2	0	.....	.....	..	..	To May, 1913.....	3	1

TABLE 21—DOMICILE RELATIONSHIP—SPARTAN MILLS—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
254 (cont'd)	1016	1913	July to Oct., 1913 (New family; counted at 342 Brawley; no further data)									
260	...	....	.....	..	..	796, 987, 1016	May to end 1913.....	8	0	To May, 1913.....	8	0
264	...	....	.....	..	..	238, 738, 987	Entire 1913.....	7	0			
265	987	1908	Dec. to end 1913..... (New family)	7	0	738	Aug. to Fall, 1913..... (No data to Aug.; moved Fall)	5	0			
271	...	....	.....	..	..	738, 987	June to end 1913.....	7	0	To June, 1913.....	7	0
272	738	1913	June to end 1913.....	6	0	238	To May, 1913.....	7	1			
277	...	....	.....	..	..	738	June to end 1913.....	3	0	To June, 1913.....	3	0
278	...	....	.....	..	..	738	June to end 1913.....	4	0	To June, 1913.....	4	0
285	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
283	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
291	...	....	See 288 Brawley									
294	...	....	See 216 Brawley									
297	...	....	.....	..	..	94, 548, 1134	June to end 1913.....	6	0	To June, 1913.....	5	0
298	...	....	.....	..	..	94	Nov. to end 1913.....	6	0	To Nov., 1913.....	6	0
303	...	....	.....	..	..	548, 94	June to end 1913.....	4	0	To June, 1913.....	4	0
304	94	1909	Nov. to end 1913..... (Family of Case 94 not counted here for 1913)	6	0	.....	.....	..	..	To Nov., 1913.....	6	0
310	...	....	.....	..	..	197, 989, 94	June to end 1913..... (No data to June)	7	0			
311	...	....	.....	..	..	197, 989, 94	Entire 1913.....	5	0			
317	197	1912	Entire 1913.....	13	1							
	989	1913	June to end 1913									
325	...	....	No data for 1913									
331	796	1913	July to end 1913..... (Family of Case 796 counted at 254 College)	5	1	.. ..	.....	..	..	To July, 1913.....	5	0
334	...	....	.....	..	..	194, 70, 739, 796	Entire 1913.....	7	0			
337	...	....	.....	..	..	198, 328, 739, 796	Entire 1913.....	6	0			
338	739	1913	June to Aug., 1913..... (Moved Aug.)	9	0	198, 328	Mar. to June, 1913.... (No data to Mar.)	10	1			
							Aug. 15 to Nov., 1913.. (New family; moved Nov.)	8	0			
	444	1907	.....	..	..	.....	Dec. to end 1913 (New family; counted at 116 Colton)					
343	198	1911	Entire 1913.....	5	0							

343 (cont'd)	328	1913	To Apr. 26, 1913 (Moved Apr.; family of Case 328 counted at 153 Laurens)									
344	626	1911	.....	..	..	198, 328, 729	Entire 1913.....	6	0			
347	...	....	.....	..	..	198	May to end 1913..... (No data to May)	6	0			
348	625	1911	.....	..	..	198, 328, 747	To Feb., 1913 (Moved Feb.; family not counted here for 1913)					
	626	1911					Feb. to end 1913..... (New family)	8	0			
Colton												
100	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	2	0
110	...	....	.....	..	..	1313	Mar. to end 1913..... (No data to Mar.)	4	0			
116	444	1907	.....	..	..	1313	To Nov., 1913..... (Moved Nov.; no) further data)	6	0			
119	1313	1912	Entire 1913.....	1	0							
122	...	....	.....	..	..	1313, 237, 1290, 1291, 1292	Entire 1913.....	10	0			
127	...	....	.....	..	..	1313, 237, 33, 1290, 1291, 1292	Entire 1913.....	2	0			
128	1290	1912	Summer to Fall, 1913...	9	0	237, 742	Fall to end 1913.....	6	0			
	1291	1912	(No data to summer; moved fall)									
	1292	1912										
131	237	1909	Entire 1913.....	3	0							
134	742	1913	Aug. to end 1913.....	2	0	237, 1290, 1291, 1292	To Aug., 1913.....	3	1			
135	...	....	No data for 1913									
138	...	....	.....	..	..	443, 742	Entire 1913.....	5	0			
142	443	1912	Entire 1913.....	6	0							
148	868	1913	Summer to end 1913.....	7	0	443	To Summer, 1913.....	9	2			
	1376	1913										
156	...	....	No data for 1913									
Dickson												
116	...	....	.....	..	..	.....	.....	..	..	May to end 1913..... (No data to May)	5	0
118	...	....	.....	..	..	1228	Aug. to end 1913.....	3	0	To Aug., 1913.....	3	0
120	1228	1913	Aug. to end 1913..... (No data to Aug.; family of Case 1228 counted at 182 Jennings)	3	0							
126	...	....	.....	..	..	1228	Aug. to end 1913.....	3	0	To Aug., 1913.....	3	0
128	...	....	.....	..	..	203, 204, 651, 652, 653, 654	Entire 1913.....	3	0			
130	203	1911	Entire 1913.....	2	0							
	204	1911										
132	515	1910	To Sept., 1913..... (Moved Sept.)	8	0							
	194	1910	Sept. to end 1913 (New family; counted at 334 Forest for 1913)									
134	...	....	.....	..	..	515, 194, 206	Entire 1913.....	5	0			

TABLE 21—DOMICILE RELATIONSHIP—SPARTAN MILLS—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Duncan												
108	1170	1912	Mar. to May, 1913..... (No data to Mar.; moved May)	3	0	232	May to end 1913..... (New family)	4	0			
104	...	....	.....	..	..	232, 1170	Mar. to end 1913..... (No data to Mar.)	4	0			
113	...	....	.....	..	..	.....	.....	..	..	June to end 1913..... (No data to June)	3	0
114	...	....	.....	..	..	1170	Mar. to May, 1913.....	6	0	May to end 1913.....	6	0
121	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
122	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
129	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
130	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
137	...	....	.....	..	..	515	Sept. to end 1913.....	4	0	To Sept., 1913.....	4	0
138	...	....	.....	..	..	515	Sept. to end 1913..... (No data to Sept.)	3	0			
145	515	1910	Sept. to end 1913..... (New family; counted at 132 Dickson)	..	..	235, 582	To Sept., 1913..... (Moved Sept.)	8	0			
146	...	....	.....	..	..	235, 515	Entire 1913.....	13	0			
153	...	....	.....	..	..	235, 515, 583	June to end 1913..... (No data to June)	5	0			
154	235	1911	Entire 1913.....	13	0							
Farley												
112	...	....	.....	..	..	436, 437, 438	Entire 1913.....	2	0			
116	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
122	...	....	.....	..	..	113, 115	Entire 1913.....	2	0			
123	115	1909	Entire 1913.....	4	0							
	113	1912	To Feb., 1913 (Moved Feb.)									
141	1014	1913	Spring to end 1913.....	6	0							
147	...	....	.....	..	..	1014, 1358	June to end 1913..... (No data to June)	13	0			
148	...	....	.....	..	..	1014	Apr. to end 1913..... (New family)	4	0	To Mar., 1913..... (Moved Mar.)	8	0
153	...	....	.....	..	..	1358	Nov. to end 1913.....	3	0	To Nov., 1913.....	3	0
154	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1913..... (No data to Mar.)	10	0
159	...	....	.....	..	..	893	To Sept., 1913.....	4	0	Sept. to end 1913.....	4	0
160	...	....	.....	..	..	893	June to Sept., 1913.... (No data to June; moved Sept.; no further data)	10	0			
166	893	1912	To Sept., 1913..... (Moved Sept.)	7	0	.....	.....	..	..	Sept. to end 1913..... (New family)	6	0
171	...	....	No data for 1913									
172	...	....	.....	..	..	238	Sept. to end 1913..... (No data to Sept.)	13	0			
177	238	1911	May to end 1913 (No data to May; family counted at 119 Manning)									

178	...	....	.....	..	..	238	May to end 1913..... (No data to Summer)	5	0			
189	...	....	See 360 Brawley									
190	...	....	.....	..	..	69	Entire 1913.....	4	0			
208	...	....	.....	..	..	69, 1170	Entire 1913.....	7	0			
213	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
214	...	....	.....	..	..	1170	Mar. to May, 1913.....	6	0	May to end 1913.....	6	0
221	...	....	.....	..	..	750	Entire 1913.....	7	0			
227	...	....	.....	..	..	750	Entire 1913.....	7	0			
229	750	1910	Entire 1913.....	2	0							
230	...	....	.....	..	..	750	Entire 1913.....	7	0			
237	...	....	.....	..	..	748, 750	Apr. to end 1913..... (No data to Apr.)	6	0			
238	...	....	.....	..	..	750	May to end 1913..... (No data to May)	9	0			
245	...	....	.....	..	..	748, 583	Apr. to end 1913..... (No data to Apr.)	9	0			
246	..	....	.....	..	..	515, 583	June to end 1913.....	10	0	Apr. to June, 1913..... (No data to Apr.)	4	0
253	...	....	.....	..	..	748, 583	Entire 1913.....	8	0			
254	583	1913	June to death, July, 1913	6	0	515	Sept. to end 1913.....	6	0	To June, 1913.....	7	1
Forest												
272	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0
276	...	....	.....	..	..	.....	.....	..	..	Aug. to end 1913..... (No data to Aug.)	5	0
304	16	1908	Aug. to end 1913..... (Family of Case 16 counted at 128 Allen)	3	0	197, 989, 796	May to Aug., 1913..... (No data to May)	3	0			
305	...	....	.....	..	..	197, 989, 445, 16	Entire 1913.....	13	0			
316	...	....	See 325 College									
317	...	....	See 317 College									
327	...	....	.....	..	..	197, 989	Aug. to end 1913..... (No data to Aug.)	4	0			
328	...	....	Pellagra Hospital									
331	...	....	.....	..	..	194, 70	Entire 1913.....	12	0			
334	70	1905	Entire 1913.....	6	0							
	194	1910	To Sept., 1913 (Moved Sept.)									
335	...	....	.....	..	..	194, 70	Entire 1913.....	4	0			
338	165	1911	.....	..	..	194, 70	Entire 1913.....	5	0			
339	...	....	.....	..	..	194, 70	Entire 1913.....	4	0			
343	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
344	...	....	.....	..	..	904	Dec. to end 1913.....	3	0	To Dec., 1913.....	3	0
349	...	....	.....	..	..	1016, 904	June to July, 1913..... Dec. to end 1913	6	0	To June, 1913..... July to Dec., 1913	6	0
352	904	1913	Dec. to end 1913.....	5	0	68	To Dec., 1913.....	6	1			
353	...	....	.....	..	..	68, 904, 1016	Entire 1913.....	12	0			
356	...	....	.....	..	..	68, 69, 904	Entire 1913.....	6	0			
357	68	1911	Entire 1913.....	6	0							
362	...	....	.....	..	..	68, 69	Entire 1913.....	6	0			
363	69	1910	Entire 1913.....	9	0							
421	...	....	.....	..	..	222, 1170	Entire 1913.....	9	0			
435	232	1911	Entire 1913.....	3	0							
439	...	..	.....	..	..	232	Entire 1913.....	6	0			
443	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
Greene												
102	...	....	.....	..	..	936, 987	Sept. to end 1913.....	7	0	Mar to Sept., 1913.... (No data to Mar.)	7	0
103	...	....	.....	..	..	936	Sept. to Nov. 25, 1913.	8	0	To Sept., 1913.....	9	0
110	...	....	.....	..	..	236, 936, 987	To June, 1913..... Sept. to end 1913	9	0	June to Sept., 1913.....	9	0

TABLE 21—DOMICILE RELATIONSHIP—SPARTAN MILLS—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
111	936	1913	Sept. to Nov. 25, 1913... (Moved Nov.; family of Case 936 not counted here for 1913)	9	0	236	To June, 1913.....	9	0	June to Sept., 1913.....	9	0
118	...	....	.....	..	..	236, 936	To June, 1913..... Sept. to Nov. 25, 1913.	11	0	June to Sept., 1913.....	11	0
119	236	1911	To June, 1913..... (Moved June)	5	0	936	Sept. to Nov. 25, 1913.	8	0	June to Sept., 1913..... (New family) Nov. 25 to end 1913	8	0
136	...	....	See 272 Brawley									
146	1134	1913	June to Aug., 1913..... (Moved Aug.)	8	0	.....	.....	..	..	To June, 1913..... Aug. to end 1913.....	9	1
154	548	1913	June to Oct., 1913..... (Moved Oct.)	7	0	.....	.....	..	..	To June, 1913..... Fall to end 1913 (New family)	8 3	1 0
102	...	....	.....	..	..	948	June to Oct., 1913.....	5	0	To June, 1913..... Oct. to end 1913	6	0
172	...	....	.....	..	..	445, 197, 989	Entire 1913.....	20	0			
181	445	1907	Oct. to Nov. 27, 1913 (Family counted at 118 Allen; no further data for 1913)									
184	...	....	See 305 Forest									
196	...	....	See 304 Forest									
201	...	....	No data for 1913									
206	...	....	.....	..	..	16, 796, 46, 60, 61	July to end 1913.....	7	0	To July, 1913.....	7	0
216	...	....	.....	..	..	328, 198, 46, 60, 61, 796	Apr. to end 1913..... (No data to Apr.)	4	0			
217	46	1912	Aug. to Oct., 1913..... (No data to Aug.; moved Oct.; no further data)	1	0							
	60	1912										
	61	1912										
	160	1910										
226	...	....	.....	..	..	198, 328, 46, 60, 61	Entire 1913.....	4	0			
Howard												
187	...	....	.....	..	..	105, 500	Entire 1913.....	8	0			
193	500	1913	Summer to end 1913.....	13	0	105	To Summer, 1913.....	7	1			
199	...	....	.....	..	..	500	Aug. to end 1913..... (No data to Aug.)	6	0			
204	...	....	.....	..	..	1419	Entire 1913.....	5	0			
205	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
212	1419	1912	Entire 1913.....	4	0							
218	...	....	.....			1419	Entire 1913.....	5	0			
222	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
230	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	11	0
236	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
254	436	1910	Entire 1913.....	5	1							
	437	1910										

254 (cont'd)	438 435	1913 1910	June to end 1913									
264	...	....	.....	..	..	436, 437, 438	Entire 1913.....	4	0			
316	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	12	0
Jennings												
110	...	....	.....	..	..	207, 650, 1290, 1291, 1292	Entire 1913.....	2	0			
111	207	1907	To Fall, 1913..... (Moved Fall)	3	0							
	1290	1912	Fall to end 1913									
	1291	1912	(New family; counted at 128 Colton for 1913)									
	1292	1912										
118	...	....	.....	..	..	207, 650, 1290, 1291, 1292	Entire 1913.....	2	0			
119	650	1913	May to Aug., 1913..... (Moved Aug.)	4	0	207, 1290, 1291, 1292	Mar. to May, 1913..... (No data to Mar.)	3	1			
							Aug. to end 1913 (New family)	6	0			
126	...	....	.....	..	..	650, 64, 65, 205	Entire 1913.....	10	0			
127	...	....	.....	..	..	.....	.....	..	..	Oct. to end 1913..... (No data to Oct.)	4	0
134	...	....	.....	..	..	295, 64, 65, 1337	Apr. to end 1913..... (No data to Apr.)	6	0			
135	...	....	.....	..	..	.....	.....	..	..	Aug. to end 1913..... (No data to Aug.)	6	0
142	...	....	.....	..	..	295, 64, 65, 1337	Mar. to end 1913..... (No data to Mar.)	10	0			
143	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	11	0
150	...	....	.....	..	..	1337, 703, 736	Entire 1913.....	6	0			
151	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
158	...	....	.....	..	..	736, 703	Entire 1913.....	8	0			
159	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
166	...	....	.....	..	..	736, 703	Entire 1913.....	8	0			
167	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
174	...	....	.....	..	..	508, 529, 530, 1228, 1167	Apr. to end 1913.....	12	0	To Apr., 1913.....	3	0
175	...	....	.....	..	..	529, 530, 1167, 1228	Apr. to end 1913.....	11	0	To Apr., 1913.....	4	0
181	1167	1913	July to end 1913.....	5	0	529, 530, 1228	Apr. to July, 1913.....	3	1	To Apr., 1913.....	2	0
182	529	1913	Apr. to Aug., 1913.....	8	2	1167	Aug. to end 1913..... (New family)	8	0	To Apr., 1913.....	5	0
	530	1913	May to death, Aug., 1913									
	1228	1913	May to Aug., 1913 (Moved Aug.)									
Johnson												
111	...	.....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
112	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
116	...	....	.....	..	..	434	Mar. to July, 1913.....	2	0	To Mar., 1913.....	3	0
										July to end 1913		
117	...	....	.....	..	..	434	Mar. to July, 1913.....	4	0	To Mar., 1913.....	4	0
										July to Oct., 1913 (Moved Oct.)		
										Oct. to end 1913..... (New family)	4	0

TABLE 21—DOMICILE RELATIONSHIP—SPARTAN MILLS—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
122	...	....	.....	..	..	424	Mar. to July, 1913.....	3	0	To Mar., 1913.....	3	0
										July to end 1913		
123	434	1912	Mar. to July, 1913..... (New family Mar.; moved July)	12	0	.....	.....	..	..	To Mar., 1913.....	10	0
										July to end 1913		
127	...	....	.....	..	..	105, 434	To Sept. 1913.....	7	0	Sept. to end 1913.....	7	0
128	...	....	.....	..	..	116, 552	Aug. to end 1913..... (No data to Aug.)	3	0			
131 (New house)	...	....	Family counted at 352 Forest									
134	...	....	.....	..	..	116, 552	Entire 1913.....	2	0			
137	116	1909	Entire 1913.....	3	1							
	552	1913	June to end 1913									
140	...	....	.....	..	..	651, 652, 653, 654, 116, 552	Entire 1913.....	2	0			
141	...	....	.....	..	..	105, 560, 116, 552	Entire 1913.....	6	0			
146	651	1913	Oct. 29 to Dec., 1913.....	..	..	651, 652, 653, 654	To Oct., 1913..... (Moved Oct.)	6	0			
	652	1913	(New family; counted at 147 Milan for 1913; no further data)									
	653	1913										
	654	1910										
147	...	....	.....	..	..	651, 652, 653, 654, 560	Summer to end 1913...	5	0	To Summer, 1913.....	5	0
178 Langford	...	....	No data for 1913									
1	...	....	No data for 1913									
2	...	....	No data for 1913									
3	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	2	0
4	...	....	No data for 1913									
5	...	....	.....	..	..	740	Feb. to Oct., 1913.....	1	0	To Feb., 1913.....	1	0
										Oct. to end 1913		
Laurens												
153	328	1912	Apr. 26 to end 1913..... (No data to Apr.)	4	0							
159	...	....	.....	..	..	1376, 443, 328, 806	Entire 1913.....	7	0			
Manning												
110	...	....	.....	..	..	238, 115, 113, 1014, 1358	Entire 1913.....	3	0			
111	...	....	.....	..	..	238, 1358	To May, 1913.....	9	0	May to Nov., 1913.....	9	0
							Nov. to end 1913					
118	1358	1913	Nov. to end 1913..... (New family)	11	0	238, 1014	To Nov., 1913..... (Moved Nov.)	5	0			

119	238	1911	To May, 1913..... (Moved May)	8	0	738, 1358	May to end 1913..... (New family)	4	0			
127	...	....	.....	..	..	1358, 238, 738	Entire 1913.....	4	0			
134	...	....	.....	..	..	238, 1358	To May, 1913..... Nov. to end 1913	6	0	May to Nov., 1913.....	6	0
135	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	10	0
142	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
143	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	9	0
150	1171	1911	.....	..	..	.....	.....	..	..	Entire 1913.....	4	0
	1172	1911										
	1173	1911										
Milan												
108	...	....	.....	..	..	519, 520	Entire 1913.....	8	0			
109	...	....	.....	..	..	519, 520	Entire 1913.....	4	0			
116	519	1911	Entire 1913.....	11	1							
	520	1913	Feb. to death, July, 1913									
117	...	....	.....	..	..	519, 520	Entire 1913.....	8	0			
123	...	....	.....	..	..	519, 520	Entire 1913.....	4	0			
124	...	....	.....	..	..	519, 520	Entire 1913.....	7	0			
128	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	5	0
129	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	7	0
134	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	10	0
135	...	....	.....	..	..	651, 652, 653, 654	Oct. to Dec., 1913.....	9	0	To Oct., 1913..... Dec. to end 1913	9	0
140	...	....	.....	..	..	651, 652, 653, 654	Sept. to Oct. 29, 1913.. (No data to Sept.)	4	0	Oct. 29 to end 1913.....	4	0
141	...	....	.....	..	..	651, 652, 653, 654	To Dec., 1913.....	3	0	Dec. to end 1913.....	3	0
147	654	1910	To Oct. 29, 1913.....	5	3	651, 652,	Nov. to end 1913.....	2	0			
	651	1913	June to Oct., 1913			653, 654,	(New family)					
	652	1913	(Moved Oct. 29)			434						
	653	1913										
148	...	....	.....	..	..	651, 652, 653, 654, 434	Entire 1913.....	4	0			
152	...	....	.....	..	..	651, 652, 653, 654, 434	Entire 1913.....	5	0			
153	434	1912	Feb. to Mar., 1913..... (Away Mar. to Aug., 1913; family of Case 434 counted at 123 Johnson) Aug. to end 1913 (Returned Aug.)	6	0	651, 652, 653, 654	To Feb., 1913..... Mar. to Aug., 1913	6	0			
158	...	....	.....	..	..	434	Feb. to Mar., 1913..... Aug. to end 1913	4	0	To Feb., 1913..... Mar. to Aug., 1913	4	0
159	...	....	.....	..	..	434	Feb. to Mar., 1913..... Aug. to end 1913	15	0	To Feb., 1913..... Mar. to Aug., 1913	7	0
165	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	8	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1913.....	6	0
Montgomery												
134												
138	718	1913	May to Fall, 1913..... (Moved Fall)	21	0	.....	.....	..	..	To May, 1913.....	18	1
142										Fall to end 1913..... (New family)	7	0

TABLE 21—DOMICILE RELATIONSHIP—SPARTAN MILLS—1913—(*Continued*)

1913	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
380	...	....	.....	..	..	718	May to Fall, 1913.....	5	0	To May, 1913..... Fall to end 1913	5	0
Oliver												
113	749	1910	.....	..	..	904	Dec. to end 1913.....	7	0	To Dec., 1913.....	7	0
114	626	1911	.....	..	..	739, 194, 70	Entire 1913.....	2	0			
119	625	1911	.....	..	..	750, 904	Entire 1913.....	6	0			
120	...	....	.....	..	..	729	June to Aug., 1913....	7	0	To June, 1913..... Aug. to end 1913	7	0
127	...	....	.....	..	..	750	Entire 1913.....	8	0			
128	...	....	.....	..	..	729	June to Aug., 1913....	6	0	To June, 1913.....	6	0
135	...	....	.....	..	..	747, 748, 750	Entire 1913.....	4	0			
136	...	....	.....	..	..	747, 748	Entire 1913.....	3	0			
141	748	1911	Entire 1913.....	4	0							
142	747	1913	Aug. to end 1913.....	6	0	748	To Aug., 1913.....	7	1			
Vaughn												
1	...	....	.....	..	..	510, 511, 512, 737, 1228, 651, 652, 653, 654	Feb. to end 1913.....	8	0	To Feb., 1913.....	8	0
2	511	1911	Feb. to end 1913..... (No data to Feb.)	7	3							
	510	1913	Apr. to end 1913									
	512	1913	May to end 1913									
	737	1913	Sept. to end 1913									
3	...	....	.....	..	..	510, 511, 512, 737, 651, 652, 653, 654	Feb. to end 1913.....	7	0	To Feb., 1913.....	7	0
Wolfe												
111	...	....	.....	..	..	25, 26, 27, 33	Feb. to Oct., 1913..... (No data to Feb.)	8	0	Oct. to end 1913.....	8	0
112	...	....	.....	..	..	25, 26, 27, 33, 1313	Entire 1913.....	5	0			
114	33	1910	To Aug., 1913..... (Moved Aug.)	4	0	25, 26, 27, 1313, 237	Aug. to end 1913..... (New family)	9	0			
115	25	1910	To Oct., 1913..... (Moved Oct.)	2	0	.....	.....	..	..	Dec. to end 1913..... (New family)	5	0
	26	1912										
	27	1912										
120	...	....	.....	..	..	237, 228, 25, 26, 27, 33	May to end 1913..... (No data to May)	3	0			
121	...	....	.....	..	..	25, 26, 27, 33	To Oct., 1913.....	5	0	Oct. to end 1913.....	5	0
122	...	....	.....	..	..	223	May to end 1913..... (No data to May)	4	0			

TABLE 22.—Domicile Relationship—Spartan Mills—1914

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Allen												
115	...	....	.....	..	..	.....	.....	..	..	To Fall, 1914..... (No further data for 1914)	2	0
117	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
118	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
124	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
127	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	9	0
128	...	....	.....	..	..	445	Entire 1914.....	8	0			
130	...	....	.....	..	..	1376, 328, 1289	June to end 1914.....	4	0	To June, 1914.....	4	0
131	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
137	...	....	.....	..	..	328, 1289	June to end 1914.....	4	0	To June, 1914.....	3	0
141	445	1907	Entire 1914.....	3	0							
145	328	1912	June to end 1914.....	6	1	.....	.....	..	..	To June, 1914.....	6	0
	1289	1914	July to end 1914..... (New family June)	..	..	.....	.....	..	..	(Moved June)		
148	...	....	.....	..	..	445, 1376	Entire 1914.....	10	0			
149	1376	1913	Summer to end 1914.....	8	0	.....	.....	..	..	To Summer, 1914.....	8	0
Arch												
371	1421	1913	To Summer, 1914 (Family counted at 302 Brawley; no further data for 1914)									
379	...	....	.....	..	..	1421	To Summer, 1914.....	8	0	Summer to end 1914...	8	0
385	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	10	0
393	...	....	.....	..	..	1084	Aug. to Oct., 1914.....	7	0	To Aug., 1914..... Oct. to end 1914	7	0
397	1084	1911	Aug. to Oct., 1914..... (No further data for 1914)	6	0							
403	...	....	.....	..	..	236, 1084	Mar. to Oct., 1914.....	8	0	To Mar., 1914..... Oct. to end 1914	8	0
409	236	1911	Mar. to Fall, 1914..... (No data to Mar.; moved Fall)	4	0	.....	.....	..	..	Fall to end 1914..... (New family)	12	0
503	...	....	No data for 1914									
Brawley												
190	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
191	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	10	0
194	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	10	0
195	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	2	0
196	...	....	No data for 1914									
197	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
201	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	8	0
202	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0
204	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	9	0
205	...	....	.....	..	..	.....	.....	..	..	To Fall, 1914..... (No further data for 1914)	9	0

TABLE 22.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
218	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	2	0
219	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
224	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
225	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
230	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
231	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	8	0
234	...	....	.....	..	..	445	Entire 1914.....	3	0			
235	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
248	...	....	.....	..	..	445	Entire 1914.....	5	0			
256	...	....	.....	..	..	445	Entire 1914.....	4	0			
272	...	....	.....	..	..	1286	Dec. to end 1914.....	3	0	To Dec., 1914.....	7	0
280	...	....	Vacant house									
288	...	....	.....	..	..	.....	.....	..	..	May to end 1914..... (No data to May)	19	0
296	...	....	.....	..	..							
302	1421	1913	Summer to end 1914..... (No data to June)	11	0	1421	Summer to end 1914...	6	0	To Summer, 1914.....	6	0
303	...	....	.....	..	..	1421, 55	Mar. to end 1914.....	5	0	To Mar., 1914.....	5	0
306	55	1912	Mar. to Apr., 1914..... (New family Mar.; moved Apr.)	13	0	1421, 493	June to end 1914.....	6	0	To Mar., 1914.....	6	0
309	...	....	.....	..	..	1421, 493, 55	Mar. to end 1914.....	4	0	To Mar., 1914.....	4	0
312	493	1913	June to Aug., 1914..... (Moved Aug.)	4	0	55	Mar. to Apr., 1914.....	2	0	To Mar., 1914.....	2	0
										Sept. to end 1914..... (New family)	5	0
316	...	....	.....	..	..	493	June to Aug., 1914....	5	0	To June, 1914..... Aug. to end 1914	5	0
324	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	8	0
334	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	12	0
339	...	....	.....	..	..	1269	June to end 1914..... (No data to June)	3	0			
342	...	....	.....	..	..	68	Entire 1914.....	6	0			
350	...	....	.....	..	..	68, 69, 1295	Feb. to end 1914..... (No data to Feb.)	14	0			
360	..	....	.....	..	..	68, 69, 1295	Entire 1914.....	16	0			
384	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
389	...	....	Vacant house									
390	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
396	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
402	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
Burnett												
109	...	....	.....	..	..	1290, 1291	Summer to end 1914...	3	0	To Summer, 1914.....	3	0
110	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	10	0
117	...	....	.....	..	..	1290, 1291, 555	May to end 1914.....	2	0	To May, 1914.....	4	0
118	...	....	.....	..	..	444, 913, 929, 1309, 555	Entire 1914.....	5	0			
127	555	1911	May to end 1914..... (New family)	5	0	64	To Apr., 1914..... (Moved Apr.)	5	0			
128	...	....	Family counted at 122 Colton for 1914									

134	...	....	Family counted at 149 Allen for 1914										
135	64	1910	Entire 1914.....	1	0								
	65*	1910											
144	...	....	.....	..	..	1337, 742, 64, 198, 1305	Entire 1914.....	1	0				
145	1337	1913	Entire 1914.....	5	0								
152	198	1911	Nov. to end 1914..f..... (Family counted at 160 Burnett for 1914)	..	..	1305, 1310, 1337, 736, 703, 198, 742	To Aug., 1914..... (Moved Aug.)	2	0				
153	...	....	.....	..	..	1337, 736, 703, 198	Entire 1914.....	6	0				
160	198	1911	Apr. to Nov., 1914..... (New family; moved Nov.; no further data for 1914)	4	0	736, 703, 1310, 742	To Apr., 1914..... (Moved Apr.)	2	0				
161	703	1912	Entire 1914.....	6	0								
	736	1913											
167	...	....	.....	..	..	1312, 1026, 703, 736, 198	Entire 1914.....	3	0				
168	...	....	.....	..	..	1312, 1026, 1310, 736, 703, 1376, 912, 868, 198	June to end 1914..... (No data to June)	11	0				
174	...	....	.....	..	..	912, 1312, 1026, 868, 1376	Entire 1914.....	10	0				
175	1312	1913	Entire 1914.....	2	1								
	1026	1914	July 23 to Sept., 1914 (Moved Sept.)										
181	...	....	.....	..	..	1312, 1026	Entire 1914.....	6	0				
182	...	....	.....	..	..	868, 912, 1312, 1026, 1376	Entire 1914.....	8	0				
Choice													
111	...	....	.....	..	..	1004, 206	To Fall, 1914.....	4	0	Fall to end 1914.....	4	0	
119	206	1911	To Apr., 1914..... (Moved Apr.)	4	0	194	Apr. to end 1914..... (New family)	2	0				
127	...	....	.....	..	..	203, 204, 206, 194, 651, 652, 653, 654, 1005	Entire 1914.....	3	0				
135	651	1913	To Fall, 1914.....	3	1	203, 204, 515, 194	Fall to end 1914..... (New family)	7	0				
	652	1913	(Moved fall)										
	653	1913											
	654	1910											
	1005	1914	June to Fall, 1914										
224	...	....	See 134-142 Montgomery										
College													
151-155	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0	
163-167	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	14	0	
178	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0	
175-179	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0	
186	...	....	.....	..	..	116, 502	Entire 1914.....	6	0				
191	...	....	.....	..	..	.....	.....	..	..	Aug. to end 1914..... (No data to Aug.)	6	0	

* Pellagrins designated in this manner are not considered active centers of the disease in this year.

TABLE 22.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
194	...	....	.....	..	..	116, 552, 590	Entire 1914.....	7	0			
254	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
260	...	...	.....	..	..	987, 1174	To Sept., 1914..... Dec. to end 1914	10	0			
264	1174	1914	Spring to Sept., 1914.... (Moved Sept.; no further data)	8	0	738	To Spring, 1914.....	16	1			
265	987	1908	To Mar., 1914..... (Moved Mar.; not counted here; see 102 Greene) Dec. to end 1914 (Returned Dec.)	..	..	738, 1174	May to Dec., 1914..... (New family; moved Dec.)	4	0			
271	...	....	.....	..	..	987, 738, 1174	Entire 1914.....	7	0			
272	738	1913	Entire 1914.....	6	0							
277	...	....	.....	..	..	738	Entire 1914.....	3	0			
278	...	....	.....	..	..	738	Entire 1914.....	4	0			
282	...	....	.....	..	..	1421	Summer to end 1914...	7	0	To Summer, 1914.....	7	0
288	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
291	...	....	See 288 Brawley									
294	...	....	See 296 Brawley									
297	...	....	.....	..	..	590, 94, 1286	To Aug., 1914..... Nov. to end 1914	8	0			
298	...	....	.....	..	..	590, 94, 1421	Entire 1914.....	6	0			
302	...	....	.....	..	..	590, 94, 940	Entire 1914.....	2	0			
304	94	1909	To Aug. 25, 1914..... (Moved Aug.)	9	0							
	590	1913	Nov. to end 1914 (Family counted at 193 Howard for 1914)									
310	...	....	.....	..	..	590, 94, 989, 197, 1293	To Aug., 1914..... Nov. to end 1914	6	0			
311	...	....	.....	..	..	940, 590, 989, 197, 1293, 94	Entire 1914.....	5	0			
317	197	1912	To June, 1914.....	9	0							
	989	1913	(Moved June; no further data for 1914)									
325	197	1912	June to end 1914.....	4	0							
	989	1913	(Family of Cases 197 and 989 counted at 317 College for 1914; no data to June)									
331	796	1913	Entire 1914.....	8	0							
	1267	1914	Early Jan. to end 1914									

234	...	....	.....	..	..	444, 796, 1267, 1259, 977	Entire 1914.....	8	0			
237	...	....	.....	..	..	444, 198, 1060, 1267, 726, 796	Entire 1914.....	7	0			
338	444	1907	To Mar., 1914..... (Moved Mar.; counted at 116 Colton for 1914)	..	..	198, 726, 1060, 1259, 977	Mar. to end 1914..... (New family)	10	0			
343	198	1911	To Apr., 1914..... (Moved Apr.; counted at 160 Burnett for 1914)	..	..	1060, 726, 893	Apr. to Fall, 1914..... (New family; moved fall; no further data for 1914)	4	0			
344	726	1911	To Feb., 1914..... (Moved Feb.; counted at 237 Farley for 1914)	..	..	747, 893	July to end 1914..... (New family)	9	0			
	1060	1913	Apr. to July, 1914..... (New family; moved July)	6	0							
347	893	1912	June to end 1914..... (No data to June)	7	0							
348	...	....	.....	..	..	198, 726, 747	To Feb. 15, 1914..... (Moved Feb.; no further data for 1914)	7	4			
Colton												
100	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
110	...	....	.....	..	..	444, 913, 939, 1313, 1309	Entire 1914.....	5	0			
116	444	1907	Mar. to end 1914..... (No data to Mar.)	8	3							
	913	1914	Summer to end 1914									
	939	1914										
	1309	1914										
119	1313	1912	Entire 1914.....	1	0							
122	...	....	.....	..	..	1313, 444, 1309, 913, 1305, 939, 1389, 237	Entire 1914.....	11	0			
127	1389	1914	Summer to end 1914.....	1	0	1313, 444, 939, 913, 1309, 237	To Summer, 1914.....	2	1			
128	1305	1914	Summer to end 1914.....	6	0	198, 237, 742	Feb. to Summer, 1914 (No data to Feb.)	7	1			
131	237	1909	Entire 1914.....	3	0							
134	742	1913	Entire 1914.....	2	0							
135	...	....	.....	..	..	237, 328, 940, 742, 1310, 1305	May to end 1914..... (No data to May)	8	0			
138	1310	1914	Summer to end 1914.....	3	0	198, 328, 742, 940	To Summer, 1914.....	4	1			
142	443	1912	.....	..	..	1376, 868, 912, 328, 1310, 940	Entire 1914.....	8	0			
148	868	1913	Entire 1914.....	15	1							
	1376	1913	To Summer, 1914									
	912	1914	Spring to end 1914									

TABLE 22.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
156	...	....	No data for 1914									
Dickson												
116	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	14	0
118	...	....	.....	..	..	1228	To Feb., 1914.....	3	0	Feb. to end 1914.....	3	0
120	1228	1913	To death, Feb., 1914.... (Family moved Feb.)	9	0	.....	.....	..	..	May to end 1914..... (New family)	6	0
126	...	....	.....	..	..	1228, 1060	To Apr., 1914.....	3	0	Apr. to end 1914.....	3	0
128	...	....	.....	..	..	203, 204, 1060, 651, 652, 653, 654, 1005	Entire 1914.....	3	0			
130	203	1911	Entire 1914.....	4	0							
	204	1911										
132	194	1910	Entire 1914.....	2	0							
134	...	....	.....	..	..	194, 206	Entire 1914.....	6	0			
Duncan												
103	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
104	...	....	.....	..	..	236	Mar. to Fall, 1914.....	4	0	Fall to end 1914.....	4	0
113	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
114	...	....	.....	..	..	236	Mar. to Fall, 1914.....	3	0	To Mar., 1914..... Fall to end 1914	3	0
121	...	....	.....	..	..	750	May to Aug., 1914.....	3	0	To May, 1914..... Aug. to end 1914	3	0
122	...	....	.....	..	..	1084	Aug. to Oct., 1914.....	7	0	To Aug., 1914..... Oct. to end 1914	7	0
129	...	....	.....	..	..	750, 1348	May to end 1914..... (No data to May)	9	0			
130	...	....	.....	..	..	1084	Aug. to Oct., 1914.....	8	0	To Aug., 1914..... Oct. to end 1914	8	0
137	...	....	.....	..	..	515, 750, 1348	June to end 1914..... (No data to June)	5	0			
138	...	....	.....	..	..	515	June to end 1914..... (No data to June)	8	0			
145	515	1910	Entire 1914.....	5	0							
146	...	....	.....	..	..	515, 1283	Entire 1914.....	14	0			
153	1283	1912	Nov. to end 1914..... (New family)	5	0	515, 1287	To Nov., 1914..... (Moved Nov.)	19	0			
154	235	1911	.....	..	..	515, 1282, 1421	Entire 1914.....	10	0			
Farley												
112	...	....	.....	..	..	437, 438	Entire 1914.....	2	0			
116	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
122	...	....	.....	..	..	115	To Nov., 1914.....	3	0	Nov. to end 1914.....	3	0
133	115	1909	To death, Nov., 1914....	4	0	.....	.....	..	..	Nov. to end 1914.....	4	0
141	...	....	.....	..	..	115, 1356	Entire 1914.....	6	0			
147	...	....	.....	..	..	1356	Apr. to end 1914..... (No data to Apr.)	5	0			
148	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	11	0
153	...	....	.....	..	..	1269, 1358	Entire 1914.....	3	0			
154	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	14	0
159	...	....	.....	..	..	1269	June to end 1914.....	4	0	To June, 1914.....	4	0

160	...	....	.....	..	..	.....	.....	..	..	Feb. to end 1914..... (No data to Feb.)	7	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	12	0
171	...	....	.....	..	..	1295	Nov. to end 1914.....	8	0	July to Nov , 1914..... (No data to July)	8	0
172	...	....	.....	..	..	1295	Nov. to end 1914.....	4	0	To Nov., 1914.....	4	0
177	238	1911	.....	..	..	1295	Nov. to end 1914.....	12	0	To Nov., 1914.....	12	0
178	1295	1914	Nov. to end 1914.....	5	0	.....	.....	..	..	To Nov., 1914.....	4	0
189	...	....	See 360 Brawley									
190	...	....	.....	..	..	69	Entire 1914.....	4	0			
208	...	....	.....	..	..	69	Entire 1914.....	7	0			
213	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
214	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
221	...	....	.....	..	..	750	Entire 1914.....	7	0			
222	...	....	.....	..	..	750	Entire 1914.....	7	0			
229	750	1910	To May, 1914..... (Moved May)	2	0	726, 750, 1348	June to end 1914..... (New family)	7	0			
230	750	1910	May to end 1914..... (Family of Case 750 counted at 229 Farley)	2	0	750	To May, 1914.....	2	0			
237	726	1911	Feb. to Dec., 1914..... (No data to Feb.; moved Dec.)	4	0	1348, 750	Dec. to end 1914.....	2	0			
238	1348	1914	Nov. 11 to end 1914..... (New family)	6	0	750, 726, 515	To Summer, 1914..... (Moved Summer)	7	0			
245	...	....	.....	..	..	1348, 748, 726, 1287	Entire 1914.....	10	0			
246	...	....	.....	..	..	515, 726, 1287, 1348, 1283	Entire 1914.....	6	0			
253	...	....	.....	..	..	748, 1287	Entire 1914.....	8	0			
254	1287	1913	Mar. to end 1914..... (No data to Mar.)	10	0							
Forest												
272	...	....	.....	..	..	328, 1280, 1376	June to end 1914.....	4	0	To June, 1914.....	4	0
276	...	....	.....	..	..	1376	June to end 1914.....	5	0	To June, 1914.....	5	0
304	16	1908	Entire 1914.....	10	0							
305	...	....	.....	..	..	197, 989, 16, 940	Entire 1914.....	15	0			
316	...	....	See 325 College									
317	...	....	See 317 College									
327	1293	1913	Feb. to Aug., 1914..... (Moved Aug.; no further data)	6	0							
328	...	....	Pellagra Hospital									
331	...	....	.....	..	..	1293, 70, 55	To Aug., 1914.....	13	0	Aug. to end 1914.....	3	0
334	70	1905	To Death, Jan. 21, 1914.	5	0	.....	.....	..	..	Feb. to end 1914.....	5	0
335	...	....	.....	..	..	55, 70, 493	To Aug., 1914.....	4	0	Aug. to end 1914.....	4	0
338	195	1911	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
339	...	....	.....	..	..	70, 493, 55	To Aug., 1914.....	4	0	Aug. to end 1914.....	4	0
343	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	12	0
344	...	....	.....	..	..	804	Entire 1914.....	3	0			
349	...	....	.....	..	..	904	Entire 1914.....	6	0			
352	904	1913	Entire 1914.....	6	0							
353	...	....	.....	..	..	68, 904	Entire 1914	8	0			
356	...	....	.....	..	..	69, 68, 904	Entire 1914.....	6	0			
357	68	1911	Entire 1914.....	4	0							
362	...	....	.....	..	..	68, 69	Entire 1914.....	6	0			
368	69	1910	Entire 1914.....	8	0							
431	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	15	0

TABLE 22.—Domicile Relationship—Spartan Mills—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
435	232	1911	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
439	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
443	...	....	.....	..	..	236	Mar. to Fall, 1914.....	14	0	To Mar., 1914..... Fall to end 1914	14	0
Greene												
102	987	1908	Mar. to July, 1914..... (No data to Mar.; moved July)	7	0	.....	.....	..	..	July to end 1914..... (New family)	8	0
108	...	....	.....	..	..	987	Mar. to July, 1914.....	5	0	To Mar., 1914..... July to end 1914	5	0
110	...	....	.....	..	..	987	May to July, 1914..... (No data to May; moved July)	7	0	July to end 1914..... (New family)	4	0
111	...	....	.....	..	..	987	Mar. to July, 1914.....	9	0	July to end 1914.....	9	0
118	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	11	0
119	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
136	...	....	See 272 Brawley									
146	1286	1914	Dec. to end 1914..... (New family; family of Case 1286 not counted here)	1	0	.....	.....	..	..	To Dec., 1914..... (Moved Dec.)	10	0
154	...	....	.....	..	..	1286	Dec. to end 1914.....	4	0	To Dec., 1914.....	4	0
162	...	....	.....	..	..	940	Oct. to end 1914.....	8	0	To Oct., 1914.....	8	0
172	940	1914	Oct. to end 1914..... (New family; counted at 159 Laurens for 1914)	..	..	989, 197	To June, 1914.....	7	0	June to Oct., 1914..... (Moved Oct.)	7	0
181	...	....	No data for 1914									
184	...	....	See 305 Forest									
196	...	....	See 304 Forest									
201	...	....	.....	..	..	1293, 16, 222	Summer to end 1914... (No data to Summer)	2	0			
206	...	....	.....	..	..	16, 1293, 1267, 796, 197, 989, 222	Entire 1914.....	8	0			
216	...	....	.....	..	..	1267, 796, 198, 222, 1293	Entire 1914.....	6	0			
217	222	1911	May to Aug., 1914..... (No data to May; moved Aug.)	5	0							
	1293	1913	Aug. to end 1914..... (New family; counted at 327 Forest)	0	0							
226	...	....	.....	..	..	198, 222, 1293, 803	Entire 1914.....	5	0			

Howard												
187	...	....	.....	..	..	590	To June, 1914.....	4	0	June to end 1914.....	5	0
193	590	1913	To June, 1914..... (Moved June)	13	0	434	Sept. to end 1914.....	7	0	June to Sept., 1914.....	7	0
199	434	1912	Apr. to May, 1914..... (No data to Apr.; away May to Sept., 1914) Sept. to end 1914 (Returned Sept.)	4	0	590	May to June, 1914.....	4	0			
204	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
205	...	....	.....	..	..	434	Sept. to end 1914.....	3	0	May to Sept., 1914..... (No data to May)	3	0
212	1410	1912	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0
218	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0
222	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
230	...	....	.....	..	..	917, 918, 919, 920	May to end 1914.....	11	0	To May, 1914.....	11	0
236	918	1914	May 1 to end 1914.....	8	0	.....	.....	..	..	To May, 1914.....	5	0
	919	1914	May 4 to end 1914									
	920	1914	May 6 to end 1914									
	917	1914	May 14 to end 1914									
254	437	1910	Entire 1914.....	4	0							
	438	1913										
264	...	....	.....	..	..	437, 438	Entire 1914.....	4	0			
316	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	12	0
Jennings												
110	...	....	.....	..	..	1290, 1291	Entire 1914.....	2	0			
111	1290	1912	To Summer, 1914..... (No further data for 1914)	1	0							
	1291	1912										
	1292	1912										
118	1290	1912	Summer to end 1914..... (Family counted at 111 Jennings)	..	..	1290, 1291, 555	To Summer, 1914..... (Moved Summer)	2	0			
	1291	1912										
	1292	1912										
119	...	....	.....	..	..	1290, 1291	Entire 1914.....	6	0			
126	...	....	.....	..	..	64, 555, 1290, 944, 1291	Entire 1914.....	4	0			
127	...	....	.....	..	..	944, 1290, 1291	Mar. 30 to end 1914....	6	0	To Mar. 30, 1914.....	5	0
134	1255	1910	.....	..	..	64, 1337	To Mar., 1914..... (Moved Mar.)	2	0			
	944	1914	Mar. 30 to end 1914.....	3	0		Mar. 15 to Mar. 30, 1914 (New family)	4	1			
135	...	....	.....	..	..	944	Mar. 30 to end 1914.... (No data to Mar.)	6	0			
142	...	....	.....	..	..	944, 64, 1337	Entire 1914.....	7	0			
143	...	....	.....	..	..	944	Mar. 30 to end 1914....	8	0	To Mar. 30, 1914.....	8	0
150	...	....	.....	..	..	703, 736, 1337	Entire 1914.....	3	0			
151	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0
158	...	....	.....	..	..	736, 703	Entire 1914.....	5	0			
159	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
166	...	....	.....	..	..	736, 703, 1026, 1312	Entire 1914.....	6	0			
167	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0

TABLE 22.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
174	...	....	.....	..	..	1167, 1312, 1026	Entire 1914.....	7	0			
175	...	....	.....	..	..	1167	To Mar., 1914.....	3	0	Mar. to end 1914.....	3	0
181	1167	1913	To Mar., 1914..... (Moved Mar.; no further data)	5	0							
182	...	....	.....	..	..	1312, 1026	June to end 1914..... (No data to June)	4	0			
Johnson												
111	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
112	...	....	.....	..	..	.....	.....	..	..	To Aug., 1914..... (Moved Aug., no further data)	5	0
116	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	2	0
117	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0
122	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	3	0
123	...	....	.....	..	..	.....	.....	..	..	To Aug., 1914..... (Moved Aug.; no further data for 1914)	5	0
127	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
128	...	....	.....	..	..	116, 552	Entire 1914.....	5	0			
131	...	....	.....	..	..	116, 552	Entire 1914.....	4	0			
134	...	....	.....	..	..	116, 552	Entire 1914.....	2	0			
137	116 552	1909 1913	Entire 1914.....	2	0							
140	...	....	.....	..	..	116, 552	Entire 1914.....	5	0			
141	...	....	.....	..	..	116, 552, 590	Entire 1914.....	6	0			
146	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	4	0
147	...	....	.....	..	..	590, 434	Entire 1914.....	5	0			
178	...	....	.....	..	..	434	To Apr., 1914.....	4	0	Apr. to end 1914.....	4	0
Langford												
1	...	....	No data for 1914									
2	...	....	No data for 1914									
3	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	2	0
4	...	....	No data for 1914									
5	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	1	0
Laurens												
153	328	1912	To Mar., 1914..... (Moved Mar.; counted at 145 Allen for 1914)	..	..	940	May to Oct., 1914..... (New family)	2	0			
159	940	1914	May to Oct., 1914..... (Moved Oct.; no further data)	6	0	868, 328, 1376	To May, 1914.....	7	1			
Manning												
110	...	....	.....	..	..	115, 1358	Entire 1914.....	3	0			

111	...	....	.....	..	..	738, 1358, 1174	Entire 1914.....	6	0			
118	1358	1913	Entire 1914.....	11	0							
119	...	....	.....	..	..	738, 1358	Entire 1914.....	5	0			
127	...	....	.....	..	..	738, 1358, 1269	Entire 1914.....	11	0			
134	...	....	.....	..	..	1358, 1269	Entire 1914.....	10	0			
135	...	....	.....	..	..	1269	June to end 1914.....	6	0	To June, 1914.....	6	0
142	1269	1914	June to end 1914.....	3	0	.....	.....	..	..	To June, 1914.....	4	1
143	....	....	.....	..	..	55, **483**, 1269	Mar. to end 1914.....	8	0	To Mar., 1914.....	8	0
150	1171	1911	.....	..	..	1269	June to end 1914.....	5	0	To June, 1914.....	4	0
	1172	1911										
	1173	1911										
Milan												
108	...	....	.....	..	..	519	To Mar., 1914.....	8	0	Mar. to end 1914.....	9	0
109	...	....	.....	..	..	519	To Mar., 1914.....	4	0	Mar. to end 1914.....	4	0
116	519	1911	To Mar., 1914..... (Moved Mar.)	10	0	493	Sept. to end 1914.....	8	0	Mar. to Sept., 1914.....	8	0
117	...	....	.....	..	..	519, 493	To Mar., 1914..... Sept. to end 1914	8	0	Mar. to Sept., 1914.....	8	0
123	...	....	.....	..	..	519, 493	To Mar., 1914..... Sept. to end 1914	4	0	Mar. to Sept., 1914.....	4	0
124	493	1913	Sept. to end 1914..... (Family of Case 493 counted at 312 Brawley)	10	0	519	To Mar., 1914.....	10	0	Mar. to Sept., 1914.....	10	0
128	...	....	.....	..	..	651, 652, 653, 654, 1005, 493	Sept. to end 1914.....	12	0	To Sept., 1914.....	12	0
129	...	....	.....	..	..	493, 1005, 651, 652, 653, 654	Sept. to end 1914.....	6	0	To Sept., 1914.....	5	0
134	651	1913	Fall to end 1914.....	..	..	.....	.....	..	..	To Fall, 1914.....	4	0
	652	1913	(New family; counted at 135 Cholce)							(Moved Fall)		
	653	1913										
	654	1910										
	1005	1914										
135	...	....	.....	..	..	651, 652, 653, 654, 1005	Fall to end 1914.....	9	0	To Fall, 1914.....	9	0
140	...	....	.....	..	..	651, 652, 653, 654, 1005	Fall to end 1914.....	4	0	To Fall, 1914.....	4	0
141	...	....	.....	..	..	.....	.....	..	..	To Fall, 1914..... (Moved Fall; no further data)	4	0
147	...	....	.....	..	..	434	To Apr., 1914.....	2	0	Apr. to end 1914.....	2	0
148	...	....	.....	..	..	434	To Apr., 1914.....	5	0	Apr. to end 1914.....	5	0
152	...	....	.....	..	..	434	To Apr., 1914.....	5	0	Apr. to end 1914.....	5	0
153	434	1912	To Apr., 1914..... (Moved Apr.; family of Case 434 counted at 199 Howard)	5	0	.....	.....	..	..	Apr. to end 1914.....	5	0
158	...	....	.....	..	..	434	To Apr., 1914.....	4	0	Apr. to end 1914.....	4	0
159	...	....	.....	..	..	434	To Apr., 1914.....	8	0	Apr. to end 1914.....	8	0
165	...	....	.....	..	..	917, 918, 919, 920	May to end 1914.....	7	0	To May, 1914.....	7	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	6	0

TABLE 22.—Domicile Relationship—Spartan Mills—1914—(*Continued*)

1914	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Montgomery												
134												
138	1004	1911	Apr. to Fall, 1914..... (Moved Fall)	26	0	.....	.....	..	..	To Apr., 1914..... Fall to end 1914	25	0
142												
280	...	....	.....	..	..	1004	Apr. to Fall, 1914.....	5	0	To Apr., 1914..... Fall to end 1914	5	0
Oliver												
113	748	1910	.....	..	..	904, 977, 1259	Entire 1914.....	7	0			
114	626	1911	.....	..	..	70	To Jan. 21, 1914.....	9	2	Jan. 21 to end 1914.....	6	0
119	625	1911	.....	..	..	977, 1259	June to end 1914.....	4	0	To June, 1914.....	2	0
120	977	1914	June to end 1914.....	4	0	.....	.....	..	..	To June, 1914.....	3	0
	1259	1914	(New family)									
127	626	1911	.....	..	..	977, 726, 1259, 750	Entire 1914.....	5	0			
128	...	....	.....	..	..	977, 444, 1259, 726, 1060	Entire 1914.....	4	0			
135	...	....	.....	..	..	748, 726, 747, 750	Entire 1914.....	4	0			
136	...	....	.....	..	..	748, 726, 747, 1060	Entire 1914.....	3	0			
141	748	1911	Entire 1914.....	3	0							
142	747	1913	Entire 1914.....	6	0							
Vaughn												
1	1060	1913	To Apr., 1914..... (Moved Apr.; family of Case 1060 counted at 344 College)	8	0	203, 204, 651, 652, 653, 654, 1005	Apr. to end 1914.....	8	0			
2	510	1913	To Apr., 1914..... (Moved Apr.)	4	0	651, 652, 653, 654, 1005	Apr. to June, 1914..... (New family; moved June)	2	0			
	511	1911										
	512	1913										
	737	1913										
	261	1911	.....	..	..	.....	.....	..	..	Oct. to end 1914..... (New family)	3	0
	263	1911										
	264	1911										
	266	1910										
3	...	....	.....	..	..	510, 511, 512, 737, 651, 652, 653, 654, 1005	To Fall, 1914.	7	0	Fall to end 1914.....	7	0
Wolfe												
111	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	8	0
112	...	....	.....	..	..	1313, 1389	Entire 1914.....	5	0			
114	...	....	.....	..	..	237, 1313, 1389	Entire 1914.....	5	0			
115	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	5	0
120	...	....	.....	..	..	237, 328	Entire 1914.....	4	0			
121	...	....	.....	..	..	.....	.....	..	..	Entire 1914.....	7	0
132	...	....	.....	..	..	328	To Mar., 1914.....	5	0	Mar. to end 1914.....	7	0

TABLE 23.—Domicile Relationship—Spartan Mills—1915

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Allen												
115	...	....	.....	..	..	.....	.....	..	..	Feb. to end 1915..... (No data to Feb.)	3	0
117	...	....	.....	..	..	445	Aug. to end 1915.....	4	0	To Aug., 1915.....	4	0
118	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	2	0
124	...	....	.....	..	..	445	Aug. to end 1915.....	3	0	To Aug., 1915.....	3	0
127	445	1907	Aug. to end 1915..... (New family; counted at 127 Johnson)	..	..	.....	.....	..	..	To Aug., 1915..... (Moved Aug.)	3	0
128	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
130	...	....	.....	..	..	328, 1376, 1289	To Sept., 1915..... (Moved Sept.)	7	0	Sept. to end 1915..... (New family)	5	0
131	...	....	.....	..	..	445	Aug. to end 1915.....	8	0	To Aug., 1915.....	8	0
137	...	....	.....	..	..	328, 1289	To Feb., 1915.....	3	0	Feb. to end 1915.....	3	0
141	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1915..... (No data to Mar.)	3	0
145	328 1289	1912 1914	To Feb., 1915..... (Moved Feb.; family of Cases 328 and 1289 counted at 216 Greene for 1915)	8	0	1376	Feb. to Sept., 1915.... (Moved Sept.)	6	0	Sept. to end 1915..... (New family)	7	0
148	...	....	.....	..	..	1376	To Sept., 1915.....	7	0	Sept. to end 1915.....	7	0
149	1376	1913	To Sept., 1915.....	8	0	.....	.....	..	..	Sept. to end 1915.....	8	0
Arch												
371	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	12	0
379	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0
385	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	11	0
393	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0
397	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
403	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0
409	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
503	...	....	No data for 1915									
Brawley												
190	...	....	.....	..	..	.....	.....	..	..	To Spring, 1915..... (Moved Spring)	3	0
										Sept. to end 1915..... (New family)	5	0
191	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0
194	...	....	.....	...	.	16	Nov. 1 to end 1915.....	9	0	To Nov., 1915.....	9	0
195	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	2	0
196	...	....	.....	..	..	16	Nov. 1 to end 1915.....	4	0	Apr. to Nov., 1915..... (No data to Apr.)	4	0
197	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0
201	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
202	...	....	.....	..	..	16	Nov. 1 to end 1915.....	5	0	To Nov., 1915.....	5	0
204	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	10	0
205	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0
218	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	2	0
219	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
224	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
225	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0

TABLE 23.—Domicile Relationship—Spartan Mills—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
230	...	....	.....	..	..	....	.....	..	..	Entire 1915.....	3	0
231	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
234	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
235	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
248	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
256	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
272	...	....	.....	..	..	1286	To Apr., 1915.....	3	0	Apr. to end 1915.....	3	0
280	...	....	Vacant house									
288	...	....	.....	..	..	1295	Mar. to end 1915.....	7	0	To Mar., 1915.....	12	0
296	...	....	.....	..	..	1295	Mar. to end 1915.....	11	0	To Mar., 1915.....	11	0
302	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
308	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
306	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
309	...	....	.....	..	..	.....	.....	..	..	To Aug., 1915..... (No further data)	5	0
312	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
316	...	....	.....	..	..	.....	.....	..	..	June to end 1915..... (No data to June)	7	0
324	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
334	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	13	0
339	...	....	.....	..	..	238, 1269	Entire 1915.....	4	0			
342	...	....	.....	..	..	68, 69, 238	Entire 1915.....	7	0			
350	...	....	.....	..	..	68, 69, 238, 1295	Entire 1915.....	10	0			
360	...	....	.....	..	..	68, 69, 238, 1295	Entire 1915.....	16	0			
384	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
389	...	....	Vacant house									
390	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
396	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
402	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0
Burnett												
109	...	....	.....	..	..	1290, 1288, 1291	Entire 1915.....	2	0			
110	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0
117	...	....	.....	..	..	1336, 555, 1303, 1290, 1291	To Fall, 1915..... (Moved Fall; no further data for 1915)	3	0			
118	...	....	.....	..	..	1303, 555, 1309, 913, 939, 444	Entire 1915.....	5	0			
127	555	1911	To Feb., 1915..... (Moved Feb.)	5	0	1290, 944, 1291, 64,	Feb. to June, 1915..... (New family)	9	1			
	1303	1915	June to end 1915.....	8	0	1336, 65, 1255						
128	...	....	.....	..	..	1309, 939, 1303, 913, 444, 555, 64, 65	Entire 1915.....	7	0			
134	...	....	Family counted at 149 Allen for 1915									

135	64 65	1910 1910	Entire 1915.....	1	0							
144	...	....	.....	..	..	198, 742, 1301, 64, 1305, 65	Early 1915..... (No further data for 1915)	5	0			
145	1337*	1913	.....	..	..	64, 65, 198, 1301, 1060, 944, 1255	Entire 1915.....	4	0			
152	198 1301	1911 1915	Entire 1915..... June to end 1915	4	1							
153	..	....	.....	..	..	198, 1060, 1301, 944, 1259, 977, 626, 627, 736, 703, 1255	Entire 1915.....	13	0			
160	977 1259 626 627	1914 1914 1911 1913	Mar. to end 1915..... (No data to Mar.)	2	0							
161	708 736	1912 1913	Entire 1915.....	5	0							
167	...	....	.....	..	..	703, 736, 626, 627, 1259, 977, 1311, 1312	Entire 1915.....	8	0			
168	...	....	.....	..	..	1259, 977, 1311, 1312, 626, 627, 1310, 443, 703, 736, 912, 868	Entire 1915.....	8	0			
174	...	....	.....	..	..	912, 868, 443, 1311, 1312	Entire 1915.....	2	0			
175	1312 1311	1913 1915	Entire 1915..... Summer to end 1915	3	1							
181	...	....	.....	..	..	1311, 1312, 1303	Entire 1915.....	5	0			
182	...	....	.....	..	..	868, 912, 1311, 1312	Entire 1915.....	8	0			
Choice												
111	...	....	.....	..	..	1427	July 15 to Aug. 7, 1915	4	0	To July 15, 1915..... Aug. 7 to end 1915	4	0
110	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
127	...	....	.....	..	..	203, 204	Entire 1915.....	4	0			
135	...	....	.....	..	..	203, 204	Entire 1915.....	7	0			
224	...	....	See 134-142 Montgomery									
College												
151-155	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
163-167	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	16	0
178	...	....	.....	..	..	445	To Aug., 1915.....	3	0	Aug. to end 1915.....	3	0
175-179	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
186	...	....	.....	..	..	445, 116, 552	Entire 1915.....	10	0			
191	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
194	...	....	.....	..	..	445, 116, 552	Entire 1915.....	12	0			
254	560	1913	June 1 to Dec., 1915..... (Family of Case 560 counted at 304 College for 1915)	19	0	.....	.....	..	..	Feb. to June, 1915..... (No data to Feb.)	3	0

* Pellagrins designated in this manner are not considered active centers of the disease in this year.

TABLE 23.—Domicile Relationship—Spartan Mills—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
260	...	....	.....	..	..	1276, 987, 500	Entire 1915.....	8	0			
264	...	....	.....	..	..	1276, 987, 738, 1425	Feb. to end 1915..... (No data to Feb.)	16	0			
265	987 1276	1908 1915	To Aug., 1915..... May 28 to Aug., 1915 (Moved Aug.; no further data)	7	1							
271	...	....	.....	..	..	987, 1276, 1279, 738	Entire 1915.....	20	0			
272	738	1913	Entire 1915.....	6	0							
277	...	....	.....	..	..	738, 1279	Entire 1915.....	4	0			
278	...	....	.....	..	..	738	Entire 1915.....	4	0			
282	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0
283	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
291	...	....	See 288 Brawley									
294	...	....	See 296 Brawley									
297	1295	1914	Mar. to end 1915..... (Family of Case 1295 counted at 178 Farley for 1915)	6	0	1286, 590	To Mar., 1915.....	5	0			
298	...	....	.....	..	..	590, 1297, 1295	Entire 1915.....	6	0			
302	...	....	.....	..	..	590, 1297, 940, 1282, 1295	Entire 1915.....	4	0			
304	500	1913	To May 1, 1915..... (Moved May)	9	0							
	1297	1914	May to end 1915..... (New family)	5	0							
310	...	....	.....	..	..	1297, 500	Mar. to end 1915..... (No data to Mar.)	10	0			
311	...	....	.....	..	..	1297, 500, 940, 1282	Entire 1915.....	5	0			
317	...	....	.....	..	..	16, 197, 980, 940, 1282	To Nov., 1915.....	7	0	Nov. to end 1915.....	7	0
325	197 980	1912 1913	To Apr., 1915..... (Moved Apr.)	12	0	796, 1267, 16, 1293, 1280	Apr. to end 1915.....	8	0			
331	1267 796	1914 1913	Entire 1915..... To May, 1915 (Moved May)	12	0							
334	1280	1915	July to end 1915.....	10	0	796, 619, 1267, 980, 197, 977, 1259	To July, 1915.....	11	1			
337	...	....	.....	..	..	1267, 328, 1280, 619, 1293	May to end 1915..... (No data to May)	6	0			
338	619	1913	Apr. to May, 1915..... (No data to Apr.; moved May)	7	0	796, 1280, 625	June to end 1915..... (New family)	7	0			

343	...	....	.....	..	..	328, 1289, 796, 1285	Oct. to end 1915..... (No data to Oct.)	5	0			
344	796	1913	May to end 1915..... (Family of Case 796 counted at 331 College for 1915)	5	0	619	Apr. to May, 1915.....	5	0	To Apr., 1915.....	5	0
347	883	1912	.....	..	..	796	May to Sept., 1915....	5	0	To May, 1915.....	8	0
	1285	1915	Sept. to Oct., 1915..... (Family of Case 1285 counted at 217 Greene for 1915)	7	0					Oct. to end 1915		
348	...	....	.....	..	..	796, 1285	Apr. to end 1915..... (No data to Apr.)	5	0			
Colton												
100	...	....	.....	..	..	.....	.....	..	..	July to Fall, 1915..... (No data to July; moved Fall; no further data)	4	0
110	...	....	.....	..	..	444, 1313, 1314, 939, 913, 1309	Entire 1915.....	16	0			
116	444	1907	Entire 1915.....	5	0							
	939	1914										
	913	1914										
	1309	1914										
119	1313	1912	Entire 1915.....	1	1							
	1314	1915	June to end 1915									
122	...	....	.....	..	..	444, 1313, 1314, 939, 913, 1309, 1305, 237, 1389	July to end 1915..... (No data to July)	4	0			
127	1389	1914	To Sept., 1915..... (Moved Sept.; no further data)	1	0							
128	1305	1914	To Sept., 1915..... (Moved Sept.; no further data)	6	0							
131	237	1909	Entire 1915.....	3	0							
134	742	1913	Entire 1915.....	2	0							
	1376	1913	Sept. to end 1915									
135	...	....	.....	..	..	237, 742, 1305, 1376, 1310	Entire 1915.....	2	0			
138	1310	1914	Entire 1915.....	3	0							
142	443	1912	To Spring, 1915..... (Moved Spring; no further data for 1915)	8	0							
148	912	1914	Entire 1915.....	11	0							
	808	1913										
156	...	....	No data for 1915									
Dickson												
116	....	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
118	....	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0
120	....	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
126	....	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
128	....	....	.....	..	..	203, 204	Entire 1915.....	3	0			
130	203	1911	Entire 1915.....	2	0							
	204	1911										

TABLE 23.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
132	184	1910	.....	..	..	203, 204	To June, 1915..... (Moved June)	2	0			
							July to end 1915..... (New family)	3	0			
134 Duncan	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
103	1358	1913	Dec. to end 1915..... (Family of Case 1358 counted at 118 Manning for 1915)	5	0	.....	.....	..	..	To Dec., 1915.....	5	0
104	...	....	.....	..	..	1358	Dec. to end 1915.....	4	0	To Dec., 1915.....	4	0
113	...	....	.....	..	..	1358	Dec. to end 1915.....	4	0	To Dec., 1915.....	4	0
114	...	....	.....	..	..	1358	Dec. to end 1915.....	3	0	To Dec., 1915.....	3	0
121	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
122	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0
129	...	....	.....	..	..	1348	Entire 1915.....	19	0			
130	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	13	0
137	...	....	.....	..	..	1348	May to end 1915..... (No data to May)	7	0			
138	...	....	.....	..	..	515	To Apr., 1915.....	2	0	Apr. to end 1915.....	2	0
145	515	1910	To Apr., 1915..... (Moved Apr.)	13	0	1287	Apr. to end 1915.....	10	0			
146	...	....	.....	..	..	515	To Apr., 1915.....	18	0	Apr. to end 1915.....	18	0
153	1283	1912	.....	..	..	1287, 515	Entire 1915.....	10	0			
154	236	1911	.....	..	..	515	To Apr., 1915.....	5	0	Apr. to end 1915.....	5	0
Farley 112	...	....	.....	..	..	436, 437, 438	Entire 1915.....	2	0			
116	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	11	0
122	...	....	.....	..	..	1426, 1427	July 18 to Sept., 1915..	3	0	To July 18, 1915..... Sept. to end 1915	3	0
133	1426	1915	July 18 to Sept., 1915....	8	0	.....	.....	..	..	Apr. to July 18, 1915... (No data to Apr.) Sept. to end 1915	6	0
	1427	1915	Aug. 7 to Sept., 1915									
141	...	....	.....	..	..	1358, 1426, 1427	To Sept., 1915.....	5	0	Sept. to end 1915.....	5	0
147	...	....	.....	..	..	1358	To Aug., 1915.....	9	0	Aug. to end 1915.....	9	0
148	...	....	.....	..	..	1174	June to end 1915..... (New family)	8	0	To May, 1915..... (Moved May)	7	0
153	...	....	.....	..	..	1174, 1209, 1358	Entire 1915.....	3	0			
154	1174	1914	May to end 1915..... (New family)	7	0	.....	.....	..	..	To May, 1915..... (Moved May)	5	0
159	...	....	.....	..	..	1209	Entire 1915.....	9	0			
160	...	....	.....	..	..	1174	May to Aug., 1915.... (No further data)	7	0	To May, 1915.....	7	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0
171	...	....	.....	..	..	238, 1295	To Mar., 1915.....	8	0	Mar. to end 1915.....	9	0
172	...	....	.....	..	..	238, 1295	To Mar., 1915.....	4	0	Mar. to end 1915.....	5	0
177	238	1911	To Mar., 1915..... (Moved Mar.)	12	0	.....	.....	..	..	Mar. to end 1915..... (New family)	11	0
178	1295	1914	To Mar., 1915..... (Moved Mar.)	5	0	.....	.....	..	..	Mar. to end 1915.....	10	0

189	...	....	See 360 Brawley										
190	...	....	.....	..	..	60	To Sept., 1915	4	0	Sept. to end 1915.....	3	0	
208	...	....	.....	..	..	60, 1358	Entire 1915.....	10	0				
213	...	....	.....	..	..	625	To Sept., 1915.....	7	0	Sept. to end 1915.....	7	0	
214	...	....	.....	..	..	1358	Dec. to end 1915.....	5	0	To Dec., 1915.....	5	0	
221	...	....	.....	..	..	625	To Sept., 1915.....	8	0	Sept. to end 1915.....	8	0	
222	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0	
229	...	....	.....	..	..	1348, 625	Entire 1915.....	5	0				
230	...	....	.....	..	..	1348	Entire 1915.....	3	0				
237	...	....	.....	..	..	1348	Entire 1915.....	6	0				
238	1348	1914	Entire 1915.....	6	0								
245	...	....	.....	..	..	748, 1348, 1287	Entire 1915.....	7	0				
246	...	....	.....	..	..	515, 1348 1287	Entire 1915.....	16	0				
253	...	....	.....	..	..	748, 1287	Entire 1915.....	6	0				
254	1287	1913	Entire 1915.....	9	0								
Forest													
272	...	....	.....	..	..	328, 1289, 1376	To Sept., 1915.....	7	0	Sept. to end 1915.....	4	0	
276	...	....	.....	..	..	.....	.....	..	..	Sept. to end 1915..... (No data to Sept.)	3	0	
304	16	1908	To Nov., 1915..... (Moved Nov.; no further data for 1915)	8	0								
305	...	....	.....	..	..	16, 197, 989, 940, 1282	Entire 1915.....	16	0				
316	...	....	See 325 College										
317	...	....	See 317 College										
327	...	....	.....	..	..	989, 197	To Apr., 1915.....	7	0	Apr. to end 1915.....	7	0	
328	...	....	Pellagra Hospital										
331	...	....	.....	..	..	.....	.....	..	..	July to end 1915..... (No data to July)	6	0	
334	...	....	.....	..	..	1280	July to end 1915	5	0	To July, 1915.....	5	0	
335	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0	
338	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0	
339	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1915..... (No data to Mar.)	4	0	
343	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0	
344	...	....	.....	..	..	904	Entire 1915.....	3	0				
349	...	....	.....	..	..	904	Entire 1915.....	7	0				
352	904	1913	Entire 1915.....	6	0								
353	...	....	.....	..	..	68, 69, 904	Entire 1915.....	9	0				
356	...	....	.....	..	..	68, 69, 904	Entire 1915.....	6	0				
357	68	1911	Entire 1915.....	4	0								
	69	1910	Sept. to end 1915										
362	...	....	.....	..	..	68, 69	Entire 1915.....	6	0				
363	69	1910	To Sept., 1915.....	8	0	68, 69	Sept to end 1915.....	8	0				
431	...	....	.....	..	..	.....	.....	..	..	To Sept., 1915..... (Moved Sept.; no further data for 1915)	7	0	
435	232	1911	.....	..	..	1358	Dec. to end 1915.....	3	6	To Dec., 1915.....	3	0	
439	...	....	.....	..	..	1358	Dec. to end 1915.....	6	0	To Dec., 1915.....	8	0	
443	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	18	0	
Greene													
102	...	....	.....	..	..	987, 1279, 1276	Entire 1915.....	14	0				
103	...	....	.....	..	..	1279	June to end 1915.....	5	0	To June, 1915.....	5	0	

TABLE 23.—Domicile Relationship—Spartan Mills—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
110	548	1913	.....	..	..	987, 1276	Mar. to June, 1915.... (No data to Mar.)	8	1			
	1279	1915	June to end 1915.....	3	0							
111	...	....	.....	..	..	1279	June to end 1915.....	6	0	To June, 1915.....	6	0
118	...	....	.....	..	..	1279	June to end 1915.....	11	0	To June, 1915.....	11	0
119	...	....	.....	..	..	1279	Aug. to end 1915..... (No data to Aug.)	6	0			
136	...	....	See 272 Brawley									
146	1286	1914	To Apr., 1915..... (Moved Apr.)	7	0	1296	Apr. to end 1915.....	5	0			
154	...	....	.....	..	..	1286, 1295	Entire 1915.....	5	0			
162	...	....	.....	..	..	940, 1282, 1295	Entire 1915.....	6	0			
172	940	1914	To Sept., 1915.....	10	1	.....	.....	..	..	Sept. to end 1915.....	2	0
	1282	1915	June to Sept., 1915 (Moved Sept.)									
181	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1915..... (No data to Mar.)	1	0
184	...	....	See 305 Forest									
186	...	....	See 304 Forest									
201	880	1911	Sept. to Oct., 1915.....	16	0	16, 328, 1285, 1289, 1293	To Sept., 1915..... Oct. to end 1915	16	0			
206	1293	1913	Entire 1915.....	12	0							
216	328	1912	Feb. to end 1915.....	3	0							
	1289	1914	(No data to Feb.)									
217	1285	1915	May to Sept., 1915..... (Moved Sept.)	2	0	328, 1289, 1293	To May., 1915.....	3	1			
	940	1914	Sept. to end 1915									
	1282	1915	(New family; counted at 172 Greene for 1915)									
226	...	....	.....	..	..	1285, 328, 940, 1289, 1293, 1282	Entire 1915.....	5	0			
Howard												
187	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
198	...	....	.....	..	..	434	Entire 1915.....	7	0			
199	434	1912	Entire 1915.....	7	0							
204	483	1913	.....	..	..	434	Entire 1915.....	5	0			
205	...	....	.....	..	..	434	Entire 1915.....	4	0			
212	1419	1912	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
218	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
222	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	2	0
230	...	....	.....	..	..	917, 918, 919, 920	Entire 1915.....	12	0			
236	917	1914	Entire 1915.....	9	0							
	918	1914										

236 (cont'd)	919 920	1914 1914										
254	435 436 437 438	1910 1910 1910 1913	Entire 1915.....	4	0							
264	...	....	.....	..	..	436, 437, 438	Entire 1915.....	8	0			
316	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	15	0
Jennings												
110	1288	1910	July to end 1915.....	2	0	1290, 1291	To July, 1915.....	2	0			
111	...	....	.....	..	..	1290, 1291, 1288, 1336	Feb. to end 1915..... (No data to Feb.)	6	0			
118	1290 1291 1292	1912 1912 1912	Entire 1915.....	1	0							
119	...	....	Family counted at 167 Burnett for 1915									
126	1336	1915	Apr. to end 1915.....	3	0	555, 1290, 1291, 944, 1255, 65, 64	To Apr., 1915.....	4	1			
127	...	....	.....	..	..	944, 1255, 1290, 1291, 1349	Entire 1915.....	6	0			
134	1255 944	1910 1914	To May, 1915..... (Moved May)	3	0	64, 65, 1303, 944, 1256, 1349, 1336	July to end 1915..... (New family)	9	0			
135	1349	1915	July 10 to end 1915..... (New family July)	3	0	944, 1255, 1336	To Spring, 1915..... (Moved Spring)	8	0			
142	944 1255	1914 1910	May to end 1915..... (Family counted at 134 Jennings for 1915)	..	..	944, 1255, 64, 65, 1060	To May, 1915..... (Moved May)	4	0			
143	...	....	.....	..	..	1349, 944, 1255, 1060	Entire 1915.....	9	0			
150	1060	1913	Apr. to July, 1915..... (Moved July; no further data for 1915)	2	0							
151	...	....	.....	..	..	944, 1255, 1060	Apr. to end 1915.....	3	0	Mar. to Apr., 1915..... (No data to Mar.)	2	0
158	...	....	.....	..	..	1060, 736, 703	Entire 1915.....	5	0			
159	...	....	.....	..	..	1060	Apr. to July, 1915.....	1	0	To Apr., 1915..... July to end 1915	1	0
166	...	....	.....	..	..	703, 736, 1311, 1312	Entire 1915.....	4	0			
167	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
174	...	....	.....	..	..	1311, 1312, 1316	To July, 1915..... (No further data for 1915)	7	0			
175	...	....	.....	..	..	1316, 1303	May to end 1915.....	2	0	To May, 1915.....	3	0
181	1316	1914	May to Fall, 1915..... (No data to May; moved fall)	4	0	1303	Fall to end 1915..... (New family)	3	0			
182	1303	1915	Fall to end 1915..... (Family counted at 127 Burnett)	..	..	1312, 1311, 1316	To Fall, 1915..... (Moved Fall)	4	0			

TABLE 23.—Domicile Relationship—Spartan Mills—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Johnson												
111	...	....	.....	..	..	590	Dec. to end 1915.....	10	0	Feb. to Dec., 1915..... (No data to Feb.)	10	0
112	590	1913	Dec. to end 1915..... (Family counted at 304 College)	..	..	.....	.....	..	..	Mar. to Dec., 1915..... (No data to Mar.)	7	0
116	...	....	.....	..	..	590	Dec. to end 1915.....	2	0	To Dec., 1915.....	2	0
117	...	....	.....	..	..	590	Dec. to end 1915.....	6	0	To Dec., 1915.....	6	0
122	...	....	.....	..	..	445	To July 30, 1915.....	8	0	July 30 to end 1915.....	5	0
123	...	....	.....	..	..	445	June to July, 1915..... (No data to June)	3	0	July 30 to end 1915.....	5	0
127	445	1907	To July 30, 1915..... (Moved July; no further data for 1915)	3	0							
128	...	....	.....	..	..	116, 552, 445	Entire 1915.....	5	0			
131	...	....	.....	..	..	116, 552, 445	Entire 1915.....	4	0			
134	...	....	.....	..	..	116, 552, 445, 590	Entire 1915.....	2	0			
137	116	1909	Entire 1915.....	2	0							
	552	1913										
140	590	1913	May to June, 1915..... (New families; family of Case 590 counted at 304 College; no further data for 1915)	3	0	116, 552	To Mar., 1915..... (Moved Mar.)	5	0			
141	...	....	.....	..	..	116, 552, 590	Feb. to end 1915..... (No data to Feb.)	3	0			
146	...	....	.....	..	..	590	May to June, 1915.....	4	0	To May, 1915..... June to end 1915	4	0
147	...	....	.....	..	..	434	Entire 1915.....	5	0			
178	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
Langford												
1	16	1908	Nov. to end 1915 (No data to Nov.; family counted at 304 Forest)	..	..							
2	...	....	No data for 1915									
3	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
4	...	....	No data for 1915									
5	...	....	.....	..	..	445	Aug. to end 1915.....	1	0	To Aug., 1915.....	1	0
Laurens												
153	...	....	.....	..	..	.....	.....	..	..	Mar. to end 1915..... (No data to Mar.)	1	0

159	...	....	.....	..	..	443, 912, 868	Aug. to end 1915..... (No data to Aug.)	5	0			
Manning												
110	...	....	.....	..	..	1426, 1427, 1358, 1425	To Fall, 1915.....	6	0	Fall to end 1915.....	6	0
111	...	....	.....	..	..	1358, 1425	To Fall, 1915.....	7	0	Fall to end 1915.....	5	0
118	1358	1913	To Aug., 1915..... (Moved Aug.)	11	0	1425	Aug. to Fall, 1915..... (New family)	2	0	Fall to end 1915.....	2	0
119	1425	1914	Mar. to Fall, 1915..... (No data to Mar.)	4	0	738	Fall to end 1915..... (New family)	7	0			
127	...	....	.....	..	..	738, 1269, 1425	July 30 to end 1915.... (No data to July 30, 1915)	7	0			
134	...	....	.....	..	..	1358, 1269, 1425	Entire 1915.....	10	0			
135	...	....	.....	..	..	1269	Entire 1915.....	6	0			
142	1269	1914	Entire 1915.....	3	0							
143	...	....	.....	..	..	1269	Entire 1915.....	8	0			
150	1171	1911	.....	..	..	1269	Entire 1915.....	5	0			
	1172	1911										
	1173	1911										
Milan												
108	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
109	...	....	.....	..	..	560	Dec. to end 1915.....	4	0	To Dec., 1915.....	4	0
116	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
117	...	....	.....	..	..	560	Dec. to end 1915.....	8	0	To Dec., 1915.....	8	0
123	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
124	462	1913	.....	..	..	.....	.....	..	..	To Feb., 1915..... (Moved Feb.)	3	0
										Feb. to end 1915..... (New families)	33	0
128	...	....	.....	..	..	1005, 651, 652, 653	Entire 1915.....	12	0			
129	...	....	.....	..	..	1005, 651, 652, 653	Entire 1915.....	6	0			
134	1005	1914	Entire 1915.....	3	0							
	651	1913										
	652	1913										
	653	1913										
	654	1910										
135	...	....	.....	..	..	560, 651, 652, 653, 1005	Entire 1915.....	9	0			
140	...	....	.....	..	..	651, 652, 653, 1005	Entire 1915.....	4	0			
141	...	....	.....	..	..	560, 651, 652, 653, 1005	Entire 1915.....	6	0			
147	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0
148	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
152	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	5	0
153	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
158	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	4	0
159	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	10	0
165	...	....	.....	..	..	917, 918, 919, 920	Entire 1915.....	11	0			
166	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	8	0

TABLE 23.—Domicile Relationship—Spartan Mills—1915—(*Continued*)

1915	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Montgomery												
134 } 138 } 142 }	1427	1915	July 15 to Aug. 7, 1915. (Family of Case 1427 counted at 133 Farley)	22	0	.....	.....	..	..	To July 15, 1915..... Aug. 7 to end 1915	28	0
380	...	....	.....	..	..	1427	July 15 to Aug. 7, 1915 (Moved Aug.)	5	0	To July 15, 1915.....	5	0
										Aug. 7 to end 1915..... (New family)	4	0
Oliver												
113	749	1910	.....	..	..	625, 977, 1259, 904	Entire 1915.....	8	0			
114	...	....	.....	..	..	625, 1259, 977, 1280	Entire 1915.....	6	0			
119	625	1911	To Sept., 1915.....	4	0	625	Sept. to end 1915.....	4	0			
120	977	1914	To Mar., 1915.....	3	0	625, 1280, 619	Mar. to end 1915.....	5	0			
	1259	1914	(Moved Mar.; family of Cases 977 and 1259 counted at 160 Burnett)									
127	...	....	.....	..	..	625, 977, 1259	Entire 1915.....	7	0			
128	625	1911	Sept. to end 1915.....	5	0	625, 796, 977, 1259, 619	To Sept., 1915.....	6	0			
135	...	....	.....	..	..	625, 748	Entire 1915.....	3	0			
136	...	....	.....	..	..	748, 796, 625	Entire 1915.....	7	0			
141	748	1911	Entire 1915.....	3	0							
142	747	1913	.....	..	..	748	Entire 1915.....	7	0			
Vaughn												
1	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	10	0
2	281	1911	.....	..	..	.....	.....	..	..	Entire 1915.....	3	0
	283	1911										
	284	1911										
	285	1910										
3	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	9	0
Wolfe												
110 (New house)	1389	1914	Sept. to end 1915 (No data to Sept.; family counted at 127 Colton)									
111	...	....	.....	..	..	1389	Sept. to end 1915.....	10	0	To Sept., 1915.....	10	0
112	...	....	.....	..	..	1313, 1314, 1389	Entire 1915.....	5	0			
114	...	....	.....	..	..	237, 1313, 1314, 1389	Mar. to end 1915..... (No data to Mar.)	4	0			
115	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	6	0
120	...	....	.....	..	..	237	Entire 1915.....	8	0			
121	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	7	0
122	...	....	.....	..	..	.....	.....	..	..	Entire 1915.....	2	0

TABLE 24.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1916

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Allen												
115	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
117	...	....	.....	..	..	445, 1285	Entire 1916 to date....	4	0			
118	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
124	...	....	.....	..	..	445	Entire 1916 to date....	3	0			
127	445	1907	Entire 1916 to date.....	4	0							
128	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	13	0
130	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
131	...	....	.....	..	..	445, 1285	Entire 1916 to date....	9	0			
137	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
141	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
145	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
148	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
149	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
Arch												
371	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
379	..	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
385	...	....	.....	..	..	1374, 1382, 1383	June, 1916, to date....	12	0	To June, 1916.....	12	0
393	...	....	.....	..	..	1374, 1382, 1383	June, 1916, to date....	6	0	To June, 1916.....	6	0
397	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
403	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	7	0
409	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	9	0
503	...	....	.....	..	..	.....	.....	..	..	Mar., 1916, to date.... (No data to Mar.)	5	0
Brawley												
190	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
191	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
194	...	....	.....	..	..	16, 1353	Entire 1916 to date....	9	0			
195	...	....	No data for 1916									
196	...	....	.....	..	..	16, 1353	Entire 1916 to date....	7	0			
197	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
201	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
202	...	....	.....	..	..	16, 1353	Entire 1916 to date....	6	0			
204	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
205	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
218	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
219	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
224	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
225	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
230	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
231	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	9	0
234	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
235	...	....	.....	..	..	1371, 1372	Aug., 1916, to date.... (Not counted for 1916)	..	..	To Aug., 1916.....	6	0
248	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
256	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
272	...	....	.....	..	..	1419	Feb., 1916, to date....	3	0	To Feb., 1916.....	3	0
280	...	....	Vacant house									
288	...	....	.....	..	..	1396	June to July, 1916.....	10	0	To June, 1916.....	10	0
296	...	....	.....	..	..	1396, 1373	June, 1916, to date....	13	0	To June, 1916.....	13	0
302	1373	1915	June 27, 1916, to date...	5	0	1421	To June, 1916.....	3	0			

TABLE 24.—Domicile Relationship—Spartan Mills—1916—(*Continued*)

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
303	...	....	.....	..	..	1421, 1373	Entire 1916 to date....	5	0			
306	1421	1913	Entire 1916 to date.....	5	0							
309	...	....	.....	..	..	1373, 1421	Entire 1916 to date....	20	0			
312	...	....	.....	..	..	1421	Entire 1916 to date....	9	0			
316	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	12	0
324	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	9	0
334	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	14	0
339	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
342	...	....	.....	..	..	68, 69	Entire 1915 to date....	7	0			
350	...	....	.....	..	..	68, 69	Entire 1916 to date....	11	0			
360	...	....	.....	..	..	68, 69	Entire 1916 to date....	10	0			
384	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
389	...	....	Vacant house									
390	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
396	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
402	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
Burnett												
109	...	....	.....	..	..	1290, 1291, 1288	Entire 1916 to date....	2	0			
110	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
117	...	....	No data to July 10, 1916; family not counted for 1916									
118	...	....	.....	..	..	444, 944, 1309	Entire 1916 to date....	5	0			
127	...	....	.....	..	..	1290, 1336, 1291, 65, 944	Mar., 1916, to date.... (No data to Mar.)	2	0			
128	944	1914	Apr., 1916, to date.....	6	0	65, 1309, 944	To Apr., 1916.....	5	0			
134	...	....	Family counted at 149 Allen for 1916									
135	64*	1910	Entire 1916 to date									
	65	1910	(No other members of family)									
144	...	....	No data to July 12, 1916; family not counted for 1916									
145	1337	1913	To July, 1916..... (Moved July; no further data for 1916)	3	0							
152	198	1911	Entire 1916 to date.....	3	0							
	1301	1915										
153	..	....	.....	..	..	1255, 944, 198, 1301, 703, 736, 1418, 1250, 977, 626, 627, 1337	Entire 1916 to date....	10	0			

* Pellagrins designated in this manner are not considered active centers of the disease in this year.

160	377 1259 626 627	1914 1914 1911 1913	Entire 1916 to date.....	2	0							
161	703 736 1418	1912 1913 1914	Entire 1916 to date..... July 15, 1916, to date	5	0							
167	...	....	.....	..	..	703, 736, 977, 627, 626, 1418, 1259, 1311, 1312, 1356	Feb., 1916, to date.... (No data to Feb.)	10	0			
168	...	....	.....	..	..	977, 1259, 626, 627, 703, 736, 1310, 1418, 1311, 1312	Entire 1916 to date....	9	0			
174	...	....	.....	..	..	1311, 1312	Entire 1916 to date....	2	0			
175	1311 1312	1915 1913	Entire 1916 to date.....	5	0							
181	...	....	.....	..	..	1311, 1312, 1303, 1356, 1302	Entire 1916 to date....	6	0			
182	...	....	.....	..	..	1311, 1312	Entire 1916 to date....	8	0			
Choice												
111	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
119	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
127	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
135	...	....	.....	..	..	1423	Feb., 1916, to date.... (No data to Feb.)	7	0			
224	...	....	See 134-142 Montgomery									
College												
151-155	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
163-167	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
178	...	....	.....	..	..	1354	To Mar., 1916.....	2	0	Mar., 1916, to date.....	2	0
175-179	...	....	.....	..	..	1354	To Mar., 1916.....	6	0	Mar., 1916, to date.....	6	0
186	...	....	.....	..	..	116, 552, 1354	Entire 1916 to date....	9	0			
191	1354	1915	To Mar., 1916..... (Moved Mar.; no further data for 1916)	6	0							
194	...	....	.....	..	..	116, 552, 1345	Entire 1916 to date....	10	0			
254	...	....	.....	..	..	.....	.....	..	..	Mar., 1916, to date..... (No data to Mar.)	3	0
260	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
264	...	....	.....	..	..	738	Entire 1916 to date....	12	0			
265	...	....	.....	..	..	1279, 738	Mar., 1916, to date.... (No data to Mar.)	8	0			
271	...	....	.....	..	..	1279, 1419, 738	Entire 1916 to date....	5	0			
272	738	1913	Entire 1916 to date.....	5	0							
277	...	....	.....	..	..	1419, 738, 1279	Entire 1916 to date....	4	0			
278	...	....	.....	..	..	738	Entire 1916 to date....	4	0			
282	...	....	.....	..	..	1373	June 27, 1916, to date.	8	0	To June 27, 1916.....	8	0
283	...	....	.....	..	..	1419	Feb., 1916, to date....	5	0	To Feb., 1916.....	5	0
291	...	....	See 288 Brawley									
294	...	....	See 296 Brawley									

TABLE 24.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1916—(*Continued*)

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
297	1396	1916	June to July, 1916.....	10	0	.....	.....	..	..	To June, 1916.....	11	0
298	...	....	.....	..	..	1396, 1373	June, 1916, to date....	7	0	To June, 1916.....	7	0
306	...	....	.....	..	..	1396	June to July, 1916.....	8	0	To June, 1916.....	5	0
304	...	....	.....	..	..	1396	June to July, 1916....	6	0	May to June, 1916..... (No data to May)	6	0
310	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	17	0
311	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
317	...	....	.....	..	..	.....	.....	..	..	To June, 1916..... (No further data)	2	0
325	...	....	.....	..	..	1280, 1405	Entire 1916 to date....	8	0			
331	1287	1914	.....	..	..	1280, 1405	Entire 1916 to date....	8	0			
	1167	1913										
334	1280	1915	To May, 1916..... (Moved May)	6	0							
	1405	1913	Feb., 1916, to date..... (New family)	3	0							
337	...	....	.....	..	..	1280, 328, 1405, 1289, 1351	Entire 1916 to date....	4	0			
338	...	....	.....	..	..	1280, 1405, 625	Entire 1916 to date....	7	0			
343	...	....	.....	..	..	328, 1289, 1285	To Apr., 1916..... (Moved Apr.; no further data)	3	0			
344	786	1913	.....	..	..	625, 1396, 1285	Entire 1916 to date.... (Family of Case 786 moved Apr.; not counted here)	5	0			
347	893	1912	.....	..	..	625	To Mar., 1916.....	3	0			
	1285	1915	Mar. to July, 1916..... (New family; moved July)	5	0							
348	786	1913	.....	..	..	1285	Mar. to July, 1916..... (No data to Mar.)	2	0			
	1396	1916	July, 1916, to date..... (New family)	6	0							
Colton 100	...	....	Family counted at 110 Colton									
110	...	....	.....	..	..	944, 444, 1313, 1314, 1309	Entire 1916 to date....	11	0			
116	444	1907	Entire 1916 to date.....	6	0							
	939	1914										
	913	1914										
	1309	1914										
119	1313	1912	Entire 1916 to date (No other members of family)									
	1314	1915										

122	..	....	.....	..	..	444, 944, 1313, 1314, 1309, 237	Entire 1916 to date....	2	0			
127	...	....	.....	..	..	444, 1313, 1314, 1309, 237	To June, 1916..... (Moved June; no further data)	2	0			
128	...	....	.....	..	..	237, 1376, 742, 1377, 198, 1301	Entire 1916 to date....	13	0			
131	237	1909	Entire 1916 to date.....	8	0							
134	742	1913	Entire 1916 to date.....	2	1							
	1376	1913										
	1377	1916	June, 1916, to date									
135	...	....	.....	..	..	237, 1395, 1376, 1377, 742, 1310	Entire 1916 to date....	5	0			
138	1310	1914	Entire 1916 to date.....	3	0							
142	...	....	No data for 1916									
148	668	1913										
	912	1914	.....	..	..	1395	Entire 1916 to date....	10	0			
156	...	....	No data for 1916									
Dickson												
116	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	9	0
118	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
120	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
126	...	....	.....	..	..	.....	.....	..	..	Mar., 1916, to date..... (No data to Mar.)	8	0
128	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
130	204	1911	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
132	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
134	...	....	.....	..	..	.....	.....	..	..	June, 1916, to date..... (No data to June)	5	0
Duncan												
103	1358	1913	Entire 1916 to date.....	10	0							
104	...	....	.....	..	..	1358	Entire 1916 to date....	4	0			
113	...	....	.....	..	..	1358	Entire 1916 to date....	8	0			
114	...	....	.....	..	..	1358	Entire 1916 to date....	2	0			
121	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
122	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
129	...	....	.....	..	..	1348, 1374, 1382, 1383	Entire 1916 to date...	10	0			
130	...	....	.....	..	..	1374, 1382, 1383	June, 1916, to date...	5	0	To June, 1916.....	5	0
137	...	....	.....	..	..	1348, 1382, 1374, 1383	Entire 1916 to date....	6	0			
138	1374	1911	June to Aug., 1916..... (New family; moved Aug.)	6	0	.....	.....	..	..	To Apr., 1916..... (Moved Apr.)	9	0
	1383	1915	Aug., 1916, to date									
	1382	1915	(New family; not counted for 1916)									
145	...	....	.....	..	..	1374, 1382, 1383	June, 1916, to date. .. (No data to June)	3	0			
146	...	....	.....	..	..	1374, 1382, 1383	June, 1916, to date...	11	0	To June, 1916.....	11	0
153	1283	1912	.....	..	..	.....	.....	..	..	Entire 1916 to date...	6	0
154	235	1911	.....	..	..	.....	.....	..	..	To June, 1916..... (Moved June; no further data)	5	0

TABLE 24.—Domicile Relationship—Spartan Mills—1916—(*Continued*)

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Farley												
112	...	....	.....	..	..	437, 438	Entire 1916 to date....	3	0			
116	...	....	.....	..	..	.....	....	..	..	Entire 1916 to date....	4	0
122	...	....	.....	..	..	... .	.....	..	..	Entire 1916 to date....	3	0
133	...	....	.....	..	..	.....	.....	..	..	Feb. to July, 1916..... (Moved July; no further data)	4	0
141	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
147	...	....	.....	..	..	.....	.....	..	..	To June, 1916..... (Moved June; no further data)	9	0
148	...	....	.....	..	..	.....	.....	..	..			
153	1374	1911	Aug., 1916, to date (No data to Aug.; family counted at 138 Duncan for 1916)			.....	.....	..	..	Entire 1916 to date....	8	0
154	1174	1914	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
159	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
160	...	....	.....	..	..	.....	.....	..	..	Mar., 1916, to date.... (No data to Mar.)	7	0
166	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	7	0
171	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
172	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
177	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	15	0
178	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
189	...	....	See 300 Brawley									
190	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
208	...	....	.....	..	..	1358	Entire 1916 to date....	10	0			
213	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	7	0
214	...	....	.....	..	..	1358	Entire 1916 to date....	7	0			
221	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
222	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
229	...	....	.....	..	..	1348	Entire 1916 to date....	5	0			
230	...	....	.....	..	..	1343	Entire 1916 to date....	2	0			
237	...	....	.....	..	..	1348	Entire 1916 to date....	5	0			
238	1348	1914	Entire 1916 to date.....	5	0							
245	...	....	.....	..	..	748	Entire 1916 to date....	5	0			
246	...	....	.....	..	..	1348	Entire 1916 to date....	10	0			
253	...	....	.....	..	..	748	Feb., 1916, to date.... (No data to Feb.)	5	0			
254	1287	1913	.....	..	..	.....	.....	..	..	Entire 1916 to date....	10	0
Forest												
272	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
276	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
304	...	....	.....	..	..	1399, 1400	June, 1916, to date....	14	0	To June, 1916.....	14	0
305	...	....	.....	..	..	1280, 1405	Entire 1916 to date....	16	0			

316	...	....	See 325 College									
317	...	....	See 317 College									
327	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	7	0
328	..	....	Pellagra Hospital									
331	...	....	.....	..	..	1421, 1373	Entire 1916 to date....	6	0			
334	...	....	.....	..	..	1280, 1405	Entire 1916 to date....	6	0			
335	...	....	.....	..	..	1421, 1373	Entire 1916 to date....	4	0			
338	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
339	...	....	.....	..	..	.....	.....	..	..	To Spring, 1916..... (No further data)	4	0
343	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
344	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
349	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
352	904	1913	.....	..	..	68, 69	Entire 1916 to date....	5	0			
353	...	....	.....	..	..	68, 69	Entire 1916 to date....	9	0			
356	...	....	.....	..	..	68, 69	Entire 1916 to date....	6	0			
357	68	1911	Entire 1916 to date.....	1	0							
	69	1910										
362	...	....	.....	..	..	68, 69	Entire 1916 to date....	7	0			
363	...	....	.....	..	..	68, 69	Entire 1916 to date....	8	0			
431	...	....	.....	..	..	1358	Entire 1916 to date....	8	0			
435	232	1911	.....	..	..	1358	Entire 1916 to date....	4	0			
439	...	....	.....	..	..	1368	Entire 1916 to date....	6	0			
443	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	9	0
Greene												
102	...	....	.....	..	..	1371, 1372, 1279	Feb., 1916, to date.... (No data to Feb.)	16	0			
103	...	....	.....	..	..	1371, 1372, 1279	Entire 1916 to date....	5	0			
110	548	1913	Entire 1916 to date.....	3	0							
	1279	1915										
111	1371	1915	Aug., 1916, to date.....	..	..	1419, 1279	To Aug., 1916.....	7	0			
	1372	1915	(Family not counted for 1916)									
118	1419	1915	Feb., 1916, to date..... (No data to Feb.)	4	0							
119	...	....	.....	..	..	1419, 1371, 1279, 1372	Entire 1916 to date....	6	0			
136	...	....	See 272 Brawley			1396	June to July, 1916.....	5	0	To June, 1916.....	5	0
146	...	....	.....	..	..	1396	June to July, 1916.....	7	0	To June, 1916.....	3	0
154	...	....	.....	..	..	1396	June to July, 1916.....	8	0	To June, 1916.....	8	0
162	...	....	.....	..	..							
172	...	....	No data for 1916									
181	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	1	0
184	...	....	See 305 Forest									
196	...	....	See 304 Forest									
201	1400	1916	June, 1916, to date.....	8	0	328, 1289, 940, 1282	To June, 1916.....	13	2			
	1399	1916										
206	...	....	.....	..	..	1399, 1400, 1351	June, 1916, to date...	9	0	Mar. to June, 1916..... (No data to Mar.)	9	0
216	328	1912	To Feb., 1916.....	3	0	1399, 1400, 940, 1282, 1351	Feb. to July, 1916..... (New family)	2	0			
	1289	1914	(Moved Feb.)									
	1351	1916	July 15, 1916, to date (New family counted at 217 Greene)									

TABLE 24.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1916—(*Continued*)

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
217	940 1282 1351	1914 1915 1916	Entire 1916 to date..... June to July 15, 1916	5	1							
226	...	....	.....	..	..	940, 1282, 1351, 1285	Mar., 1916, to date.... (No data to Mar.)	8	0			
Howard												
187	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
193	...	....	.....	..	..	434, 500	To Spring, 1916..... July, 1916, to date	7	0	Spring to July, 1916...	7	0
199	434	1912	To Spring, 1916..... (Moved Spring)	7	0	.....	.....	..	..	Spring to July, 1916...	4	0
	500	1913	July, 1916, to date (Family of Case 500 counted at 112 Johnson)									
204	483	1913	.....	..	..	1419, 500	To Feb., 1916..... July, 1916, to date	3	0	Feb. to July, 1916.....	3	0
205	...	....	.....	..	..	434, 500	To Spring, 1916..... July, 1916, to date	5	0	Spring to July, 1916...	5	0
212	1419	1913	To Feb., 1916 (Moved Feb.; no further data; family counted at 118 Greene)									
218	...	....	.....	..	..	1419	To Feb., 1916.....	6	0	Feb., 1916, to date.....	6	0
222	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
230	...	....	.....	..	..	917	Entire 1916 to date....	12	0			
236	917 918 919 920	1914 1914 1914 1914	Entire 1916 to date.....	7	0							
264	437 438	1910 1913	Entire 1916 to date.....	4	0							
264	...	....	.....	..	..	437, 438	Entire 1916 to date...	5	0	Entire 1916 to date....	14	0
316	...	....	.....	..	..	.....	.....	..	..			
Jennings												
110	1288	1910	Entire 1916 to date.....	2	0							
111	...	....	.....	..	..	1288, 1290, 1291	Entire 1916 to date...	6	0			
118	1290 1291 1292	1912 1912 1912	Entire 1916 to date.....	1	0							
119	...	....	.....	..	..	1290, 1291, 1336, 1288	May, 1916, to date... (No data to May)	4	0			
126	1336	1915	Entire 1916 to date.....	3	0							
127	...	....	.....	..	..	1290, 1291, 1336	Entire 1916 to date...	4	0			
134	...	....	.....	..	..	65, 1287, 1336, 1256, 944	Entire 1916 to date....	4	0			

135	...	....	.....	..	..	1336	May, 1916, to date.... (No data to May)	5	0			
142	1255 944	1910 1914	To Feb., 1916..... (Moved Feb.)	3	0	65, 1337	Mar., 1916, to date.... (New family Mar.)	2	0			
143	...	....	.....	..	..	1255, 944	To Feb., 1916.....	7	0	Feb., 1916, to date.....	7	0
150	...	....	.....	..	..	1337, 1418, 736, 703, 1255, 944	Entire 1916 to date....	3	0			
151	...	....	.....	..	..	.....	.....	..	..	Apr., 1916, to date..... (No data to Apr.)	3	0
158	...	....	....	..	..	1418, 703, 736	Entire 1916 to date....	5	0			
159	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	1	0
166	...	....	.....	..	..	1311, 736, 1312, 703, 1418, 1356	Entire 1916 to date....	12	0			
167	...	....	.....	..	..	1356	Apr., 1916, to date....	5	0	To Apr., 1916.....	5	0
174	1356	1916	Apr., 1916, to date..... (No data to Apr.)	5	0							
175	...	....	.....			1356, 1353, 1303, 1362	Entire 1916 to date....	3	0			
181	1353	1916	Aug., 1916, to date..... (Family not counted here for 1916)	..	..	1356, 1303, 1362	To Aug., 1916.....	4	0			
182	1303	1915	To June, 1916..... (Moved June)	2	0							
	1362	1916	July, 1916, to date..... (New family)	3	0							
Johnson												
111	...	....	.....	..	..	500	To July, 1916.....	10	0			
112	500	1913	To July, 1916..... (Moved July)	8	0							
116	...	....	.....	..	..	500, 1354	To July, 1916.....	2	0			
117	...	....	.....	..	..	500, 1354	To July, 1916.....	6	0			
122	...	....	.....	..	..	1354	Mar. to Apr., 1916.....	5	0	To Mar., 1916.....	5	0
123	1354	1915	Mar. to Apr., 1916..... (Moved Apr.)	5	0	.....	.....	..	..	Apr., 1916, to date To Mar., 1916.....	5	0
										July, 1916, to date..... (New family)	2	0
127	...	....	.....	..	..	.....	.....	..	..	Spring, 1916, to date... (No data to Spring)	3	0
128	...	....	.....	..	..	116, 552, 1354	Entire 1916 to date....	5	0			
131	...	....	.....	..	..	116, 552	Entire 1916 to date....	4	0			
134	...	....	.....	..	..	116, 552	Entire 1916 to date....	2	0			
137	116 552	1900 1913	Entire 1916 to date.....	2	0							
140	...	....	.....	..	..	116, 552	Entire 1916 to date....	4	0			
141	...	....	.....	..	..	116, 552	May, 1916, to date.... (No data to May)	3	0			
146	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
147	...	....	.....	..	..	434, 500	To Spring, 1916..... (Moved Spring)	5	0	Spring to July, 1916... (New family)	3	0
							July, 1916, to date	3	0			
178	...	....	.....	..	..	.....	.....	..	..	June, 1916, to date..... (No data to June)	5	0

TABLE 24.—DOMICILE RELATIONSHIP—SPARTAN MILLS—1916—(*Continued*)

1916	Zone 1					Zone 2				Zone 3		
House Street and Number	Antecedent Case	First Erythema	Time in Zone 1	Exposed Population		Antecedent Case	Time in Zone 2	Exposed Population		Time in Zone 3	Exposed Population	
				Total	Incident Cases			Total	Incident Cases		Total	Incident Cases
Langford												
1	16	1908	Entire 1916 to date.....	6	1							
	1353	1916	Apr. to Aug., 1916									
2	...	.....	.....	..	..	1353, 16	Mar., 1916, to date.... (No data to Mar.)	2	0			
3	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
4	...	....	.....	..	..	445, 1285	Apr., 1916, to date.... (No data to Apr.)	4	0			
5	1285	1915	July, 1916, to date..... (Family of Case 1285 counted at 347 College for 1916)	1	0	445	To July, 1916.....	1	0			
Laurens												
158	...	....	.....	..	..	1395	Entire 1916 to date....	1	0			
159	1395	1915	Entire 1916 to date.....	1	0							
Manning												
110	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
111	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
118	...	....	No data for 1916									
119	...	....	.....	..	..	738	Entire 1916 to date....	15	0			
127	...	....	.....	..	..	738	Entire 1916 to date....	16	0			
134	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	8	0
135	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
142	1269	1914	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
143	...	....	.....	..	..	1421	Entire 1916 to date....	8	0			
150	1171	1911	.....	..	..	.....	.....	..	..	Entire 1916 to date....	6	0
	1172	1911										
	1173	1911										
Milan												
108	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	9	0
109	...	...	.....	..	..	590	To July, 1916.....	4	0			
116	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	9	0
117	...	....	.....	..	..	590	To July, 1916.....	8	0			
123	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	4	0
124	...	....	.....	..	..	.....	.....	..	..	To Spring, 1916..... (Moved Spring; no further data)	8	0
128	...	....	.....	..	..	651, 652, 653	Entire 1916 to date....	12	0			
129	...	....	.....	..	..	651, 652, 653	Entire 1916 to date....	6	0			
134	651	1913	Entire 1916 to date.....	3	0							
	652	1913										
	653	1913										
	654	1910										
	1005	1914										

135	...	....	.....	..	..	651, 652, 653	Entire 1916 to date....	13	0			
140	...	....	.....	..	..	651, 652, 653	Entire 1916 to date....	4	0			
141	..	...	.....	..	..	651, 652, 653	Entire 1916 to date....	4	0			
147	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	4	0
148	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
152	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	5	0
153	...	....	.....	..	..	.....	.....	..	..	To Spring, 1916..... (Moved Spring; no further data)	3	0
156	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	4	0
159	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	2	0
165	...	....	.....	..	..	917	Entire 1916 to date....	5	0			
166	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	8	0
Montgomery												
134 | 138 | 142	..	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	17	0
380	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	4	0
Oliver												
113	748	1910	.....	..	..	.....	.....	..	..	Entire 1916 to date...	8	0
114	...	....	.....	..	..	1280, 1405	Entire 1916 to date....	7	0			
119	...	....	.....	..	..	625	Entire 1916 to date....	11	0			
120	...	....	.....	..	..	1280, 1405, 625	Entire 1916 to date....	5	0			
127	...	....	.....	..	..	625	Entire 1916 to date....	7	0			
128	625	1911	Entire 1916 to date.....	5	0							
135	...	....	.....	..	..	625, 748	Entire 1916 to date....	4	0			
136	...	....	.....	..	..	625, 748, 1396	Entire 1916 to date....	8	0			
141	748	1911	Entire 1916 to date.....	4	0							
142	747	1913	.....	..	..	748	Entire 1916 to date...	5	0			
Vaughn												
1	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date....	3	0
2	281	1911	.....	..	..	1423	Feb., 1916, to date....	3	0	To Feb., 1916.....	3	0
	283	1911										
	284	1911										
	285	1910										
3	1423	1915	Feb.. 1916, to date..... (No data to Feb.)	4	0							
Woife												
109 (New house)	...	....	.....	..	..	1389	Entire 1916 to date...	5	0			
110	1389	1914	Entire 1916 to date.....	1	0							
111	...	....	No data for 1916									
112	...	....	.....	..	..	1389, 1313, 1314	Entire 1916 to date....	2	0			
114	...	....	.....	..	..	1213, 1314, 237	Entire 1916 to date....	9	0			
115	...	....	.....	..	..	.....	.....	..	..	May, 1916, to date.... (No data to May)	8	0
120	...	....	.....	..	..	237	Entire 1916 to date....	8	0			
121	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	7	0
139	...	....	.....	..	..	.....	.....	..	..	Entire 1916 to date...	?	0